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ACE PLAN

Aviation Capacity Enhancement Plan

U.S. Department of Transportation
Federal Aviation Administration

2001

Aviation Capacity
Enhancement Plan

Building Capacity Today for the Skies of Tomorrow

Federal Aviation Administration
Office of System Capacity

December 2001

Prepared jointly by the Federal Aviation Administration
and ARP Consulting, L.L.C.

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The Aviation Capacity Enhancement (ACE) Plan is published annually by the Federal Aviation Administration's (FAA) Office of System Capacity. Its purpose is to provide the aviation industry with a summary of significant accomplishments of FAA-related programs, technologies, and initiatives affecting the capacity of the National Airspace System. The ACE Plan's audience consists of airports, airlines, aviation organizations, and academia that have a vested interest in U.S. aviation. The ACE Plan is also distributed to members of Congress.

The ACE Plan contains data for Fiscal Year (FY) 2000 (October 1, 1999–September 30, 2000) and for Calendar Year (CY) 2000. Since forecasts are available only for fiscal years, all data relating to those forecasts are for fiscal years. Other data, such as delays, are presented for the most recent calendar year. Appendices B and C provide comparative data for last 3 fiscal and calendar years.

Chapter 1 – Capacity Benchmarks
Contains an overview of the FAA's Airport Capacity Benchmark Report released in 2001, which documents the number of flights that can be handled under optimum and less than optimum weather conditions at 31 of the busiest U.S. airports. Initiatives to enhance capacity at the eight most delayed airports in the United States are also described.

Chapter 2 – National Airspace System Performance and Aviation Activity
Summarizes current and projected aviation activity and discusses the performance of the National Airspace System. It also discusses new sources of demand for air traffic services, such as new large aircraft and regional jets.

Chapter 3 – Airport Capacity, Analysis and Enhancements
Contains an overview of airport development, including the FAA's initiatives to improve the timeliness of the environmental review process, and an update of airport construction projects.

Chapter 4 – Airspace Design
Summarizes FAA programs to redesign airspace to maximize efficient traffic flow. Describes recent progress in addressing seven airspace choke points, the development of area navigation routes, and initiatives to consolidate control of busy airspace within a single facility to enable closer spacing of aircraft and more efficient routing.

Chapter 5 – Operational Procedures
Offers an update on new and proposed procedures to increase capacity with little or no investment in airport infrastructure or equipment. It also includes an update on the Spring/Summer 2001 (SS 2K+1) Plan building upon the program that began during the previous year.

Chapter 6 – National Airspace System Modernization
Contains an overview of the FAA's NAS modernization efforts as outlined in the Operational Evolution Plan (OEP), including its short-, mid- and long-term outlook.

The chapters are supported by additional information on aviation activity and construction projects at the 100 U.S. airports in a series of appendices:

Appendix A
Describes the basic elements of the National Airspace System and includes information on commercial and general aviation airports.

Appendix B
Provides historical, current, and forecast information on passenger enplanements and aircraft operations, at the top 100 U.S. airports, as ranked by enplanements.

Appendix C
Summarizes the status of the recommendations of completed Capacity Enhancement Plans.

Appendix D
Summarizes runway construction projects that are proposed or planned for 2006 and beyond.

Appendix E
Presents airport layouts highlighting current capacity enhancement projects.

Appendix F
Defines acronyms used in the ACE Plan.

Appendix G
Lists the references used to prepare the ACE Plan and credits for materials from FAA and non-FAA sources.

INTRODUCTION

2001 – A Year of Unprecedented Challenges

At press time for the 2001 ACE Plan, the long-term impact of the September 11 attacks on both traffic and capacity was uncertain. The attacks resulted in an immediate reduction in air travel, making the FAA's forecasts of aviation activity nearly obsolete. Airlines have been revising their flight schedules, monitoring traffic levels, and conducting analytical modeling to reforecast projected demand. Airports are reviewing their plans to add capacity through the construction of new runways or extension of existing runways. While some airports are continuing with construction plans, others have put their projects on hold.

It is unclear how long the reduction in flight activity will continue. The FAA's ability to accurately forecast demand at individual airports will be limited in the near turn. We have chosen to issue the 2001 ACE Plan as it was drafted prior to the September 11 attack since it is too early to accurately assess the lasting impact of these attacks. The 2002 ACE Plan will contain revised forecasts and a summary of how the attacks have affected the NAS.

A New Perspective on Delays

While the aviation industry's focus has drastically shifted from delays to security, through August 2001, the National Airspace System experienced an improvement in performance. The chronic flight delay problems in 1999 and 2000 triggered an extraordinary collaborative effort between the FAA and the aviation industry, resulting in several concurrent initiatives to improve air traffic flow and reduce flight delays. This effort appears to have halted the recent trend of double-digit increases in delays. Delays for January to August 2001 were four percent lower than for the same period for the previous year. In figure I-1, delay by cause is compared for January through September 2000 and 2001:

Figure I-1 Delays by Cause, 2001 vs. 2000

		Delays	Weather	Volume	Equip	Runway	Other
Jan-01	Actual ➣	27,894	18,660	4,404	204	2,050	2,576
Jan-00	Actual ➣	26,015	18,744	3,255	1,178	1,008	1,830
	% Difference	7	(0.4)	35	(83)	103	41
Feb-01	Actual ➣	31,599	23,697	3,827	200	1,491	2,384
Feb-00	Actual ➣	27,208	18,191	4,111	552	2,215	2,139
	% Difference	16	30	(7)	(64)	(33)	11
Mar-01	Actual ➣	30,040	20,777	3,750	1,555	1,539	2,419
Mar-00	Actual ➣	32,205	22,052	4,771	828	1,948	2,606
	% Difference	(7)	(6)	(21)	88	(21)	(7)
Apr-01	Actual ➣	30,260	21,127	3,605	685	2,130	2,713
Apr-00	Actual ➣	35,332	24,029	4,469	1,526	1,789	3,519
	% Difference	(14)	(12)	(19)	(55)	19	(23)
May-01	Actual ➣	36,460	25,044	4,102	788	1,806	4,720
May-00	Actual ➣	36,570	27,819	3,589	373	1,892	2,897
	% Difference	(0.3)	(10)	14	111	(5)	63

Figure I-1 continued

		Delays	Weather	Volume	Equip	Runway	Other
Jun-01	Actual ➢	41,607	32,668	4,337	425	1,237	2,940
Jun-00	Actual ➢	50,114	39,640	3,262	241	2,584	4,387
	% Difference	(17)	(18)	33	76	(52)	(33)
Jul-01	Actual ➢	40,037	29,072	4,371	650	2,611	3,333
Jul-00	Actual ➢	44,430	34,611	4,108	217	2,139	3,355
	% Difference	(10)	(16)	6	200	22	(1)
Aug-01	Actual ➢	49,423	38,306	5,218	444	2,015	3,440
Aug-00	Actual ➢	47,893	33,339	5,397	452	2,960	5,745
	% Difference	3	15	(3)	(2)	(32)	(40)
Total-01	Actual ➢	287,320	209,351	33,614	4,951	14,879	24,525
Total-00	Actual ➢	299,767	218,425	32,962	5,367	16,535	26,478
	% Difference	(4)	(4)	2	(8)	(10)	(7)
Sep-01*	Actual ➢	18,628	13,406	2,365	70	1,083	1,704
Sep-00	Actual ➢	43,357	27,094	7,839	131	3,192	5,101
	% Difference	(57)	(51)	(70)	(47)	(66)	(67)

Data Source: OPSNET, FAA

* Sep 01 statistics reflect the impact of the NAS shutdown for 2 days following Sep 11 events and gradual traffic recovery to 85% of system traffic levels.

The FAA has implemented several operational changes that have improved the efficiency of air traffic management. For example, the FAA's air traffic controllers have improved their procedures for processing flights during storms by making more alternate routes available, enabling more flights to fly around the storms. Additionally, the FAA's Air Traffic Control System Command Center (commonly referred to as the Command Center) is limiting the use of ground stops, which suspend flight departures until storm activity subsides. The Command Center is also conducting conference calls with airline and air traffic control representatives every two hours to formulate two- and six-hour plans for addressing problems caused by adverse weather or high traffic volume. The FAA has targeted delays caused by traffic en route by implementing a series of changes to address seven congested airspace regions referred to as "choke points." While air traffic is currently below normal levels, the effects of these initiatives continue to be beneficial.

The Airport Capacity Benchmark Report Assists in Airport Planning

The first chapter of the 2001 ACE Plan highlights a recent FAA report on airport capacity benchmarks for 31 of the busiest U.S. airports. The Benchmark Report provides two rates for each airport—an optimum rate and a reduced rate—based on the number of flight arrivals and departures that the airport can routinely handle under ideal and adverse weather conditions. The Benchmark Report compares scheduled traffic at these airports compares to capacity under the optimum and reduced conditions. It also projects changes to the benchmark rates from the completion of planned capacity enhancements. The Benchmark Report is featured in the ACE Plan because of its importance in the FAA's efforts to reduce delays and increase capacity this year. The Benchmark Report will serve as a starting point for future analysis of capacity problems and the evaluation of proposed solutions.

The Operational Evolution Plan – the FAA's Commitment to Excellence

The Operational Evolution Plan (OEP) was prepared by the FAA with the collaboration of many industry participants. It was released to the public and presented to Congress in testimony by the Administrator in June 2001. The OEP is an operationally-oriented plan for the evolution of the NAS that integrates and aligns FAA's activities with those of the airports and the airlines. The OEP's capacity enhancements are divided into near-term (2001), mid-term (2002–2005), and long-term (2005–2010) projects. The OEP is a living document that is being continually revised to reflect accomplishments, as well as changes in the needs of the aviation community. As 2001 comes to a close, some OEP projects have been completed and other projects are being reclassified and rescheduled.

A Pragmatic Approach For Continued Progress

Although 2001 was filled with unprecedented challenges, the reduction in chronic delays provides an opportunity for the FAA to implement additional initiatives and to extend the improvements accomplished in 2001 to 2002 and beyond. Air travel remains one of our nation's most vital services and the FAA will continue its commitment to provide a safe, secure and efficient National Airspace System.

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CAPACITY BENCHMARKS

1 CAPACITY BENCHMARKS

This chapter provides an overview of the FAA Airport Capacity Benchmark Report 2001, which analyzed capacity at 31 of the busiest U.S. airports.

In return for purchasing a ticket and arriving at the airport on time, passengers expect their flights to depart and arrive on schedule. When the weather is good, most flights do depart on time, and many of those that depart late can make up lost time in the air. But on a bad day, when storms cause disruptions at or between key airports, hundreds of flights are delayed throughout the national airspace system.

In recent years growth in air passenger traffic has outpaced growth in aviation system capacity. As a result, the effects of adverse weather or other disruptions to flight schedules are more substantial than in years past; more flights are delayed, affecting more passengers (Figure 1-1). This trend is most pronounced during the summer months when traffic is heavy and convective storms effectively shut down key airports and sectors of airspace for several hours at a time. Figure 1-2, which depicts the variation in delays by month, shows that the total number of delays closely tracks the number of weather delays, and that both are sharply higher during the late spring and summer.

Figure 1-1 CY 1995-2000 Percentage Change in U.S. Operations, Enplanements, and Delays

	1995	2000
Operations (M)	62.0	68.7
Enplanements (M)	598.0	706.0
Delays (K)	237.0	450.0

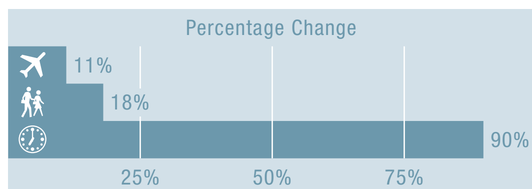
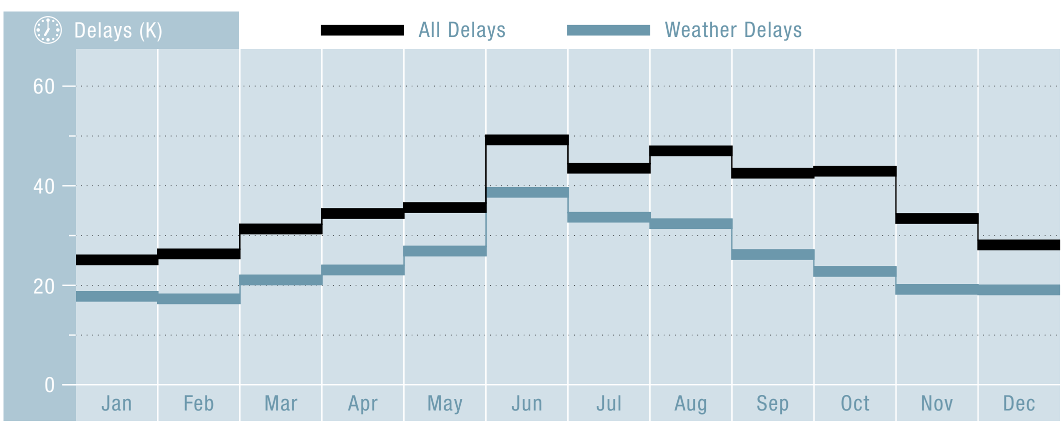


Figure 1-2 Total Delays and Weather Delays by Month CY 2000



In the Fall of 2000 the Department of Transportation, in response to a congressional request, tasked the FAA with developing capacity benchmarks for the nation's busiest airports. The call for benchmarks was primarily motivated by two consecutive summers in which delays increased sharply, despite targeted FAA initiatives to remedy the problem. The FAA's Office of System Capacity played a key role in developing the benchmarks.

1.1 Methodology

The *FAA Airport Capacity Benchmark Report 2001* analyzed capacity at 31 airports: the 30 busiest U.S. passenger airports; and Memphis, a major cargo airport. In CY 2000, these airports accounted for sixty percent of passenger enplanements, and ninety percent of flights delayed 15 or more minutes. The objective of the Benchmark Report was to document the number of flights these airports can handle under optimum and less than optimum weather conditions, and to project future capacity based on plans for new runways, revised air traffic procedures, and technological improvements.

For the purpose of the Benchmark Report, capacity benchmarks were defined as the maximum number of flight arrivals and departures that an airport can routinely handle in an hour. Two benchmark rates were calculated for each airport: an optimum rate and a reduced rate. The optimum rate was defined as the maximum number of aircraft that can routinely be handled using visual approaches during periods of unlimited ceiling and visibility, when there are no traffic constraints in the en route system or airport terminal area. The reduced rate was defined as the number of aircraft that can be handled during periods of poor visibility when radar is required to ensure separation between aircraft, for the runway configuration most commonly used in adverse weather.

Benchmark rates for each airport were estimated by the air traffic controllers for that airport based on their experience in handling flights on a daily basis, and calculated using a computer model of airfield capacity. The facility-provided and calculated estimates were compared to historical arrival and departure data to confirm their validity. In addition, FAA representatives visited several of the airports to validate the methodology.

The benchmarks were then compared to air carrier flight schedules for each airport (based on the Official Airline Guide) to document how frequently scheduled demand exceeds the benchmarks under ideal and less-than-ideal conditions. Capacity benchmarks can be exceeded for a short period of time without producing a large number of delays, but when the number of scheduled flights exceeds the benchmark for sustained periods of time, delays are inevitable.

1.2 Findings

Figure 1-3 shows the following information for the benchmarked airports: optimum and reduced rates; percent difference between those rates; percent of time under instrument flight rules in CY 2000; and delay rate in CY 2000. The airports in Figure 1-3 are listed from the highest to the lowest delay rate. The first eight airports on the list, which have the highest delay rates in the U.S., have been designated as “pacing” airports. These airports are currently the focus of intensified FAA efforts to improve operational efficiency and enhance capacity.

Figure 1-3 Optimum and Reduced Rates at the 31 Benchmarked Airports

Airport (ID)	Optimum Rate	Reduced Rate	Capacity Loss	Percent Time IFR	Delay Rate
New York LaGuardia (LGA)	81	64	21%	20%	155.9
Newark International (EWR)	108	78	28%	19%	81.2
Chicago O'Hare International (ORD)	202	160	21%	15%	63.3
San Francisco International (SFO)	99	72	27%	26%	56.9
Boston Logan International (BOS)	126	88	30%	18%	47.5
Philadelphia International (PHL)	110	96	13%	15%	44.5
New York John F. Kennedy International (JFK)	98	71	28%	14%	38.8
Atlanta Hartsfield International (ATL)	200	174	13%	23%	30.9
George Bush Intercontinental (IAH)	123	113	8%	24%	28.1
Dallas-Fort Worth International (DFW)	270	185	31%	17%	23.8
Phoenix Sky Harbor International (PHX)	110	65	41%	1%	22.0
Los Angeles International (LAX)	150	128	15%	18%	21.9
Washington Dulles International (IAD)	121	117	3%	20%	19.5
Lambert St. Louis International (STL)	112	65	42%	23%	18.2
Detroit Metro Wayne County (DTW)	146	138	5%	23%	17.6
Cincinnati-Northern Kentucky (CVG)	125	125	0%	43%	15.4
Minneapolis-St. Paul International (MSP)	120	112	7%	31%	12.7
Miami International (MIA)	134	108	19%	3%	11.3
Seattle-Tacoma International (SEA)	91	81	11%	29%	10.4
Las Vegas McCarran International (LAS)	85	57	33%	1%	8.0
Ronald Reagan National (DCA)	80	66	18%	14%	8.0
Baltimore-Washington International (BWI)	120	75	38%	13%	6.9
Orlando International (MCO)	145	112	23%	5%	6.3
Charlotte/Douglas International (CLT)	140	116	17%	18%	6.0
Greater Pittsburgh International (PIT)	160	131	18%	14%	3.8
San Diego International Lindbergh Field (SAN)	57	49	14%	30%	2.5
Denver International (DEN)	218	196	10%	7%	2.2
Salt Lake City International (SLC)	132	105	20%	15%	2.0
Tampa International (TPA)	119	87	27%	4%	1.6
Memphis International (MEM)	152	120	21%	21%	0.4
Honolulu International (HNL)	126	60	52%	N/A	0.0

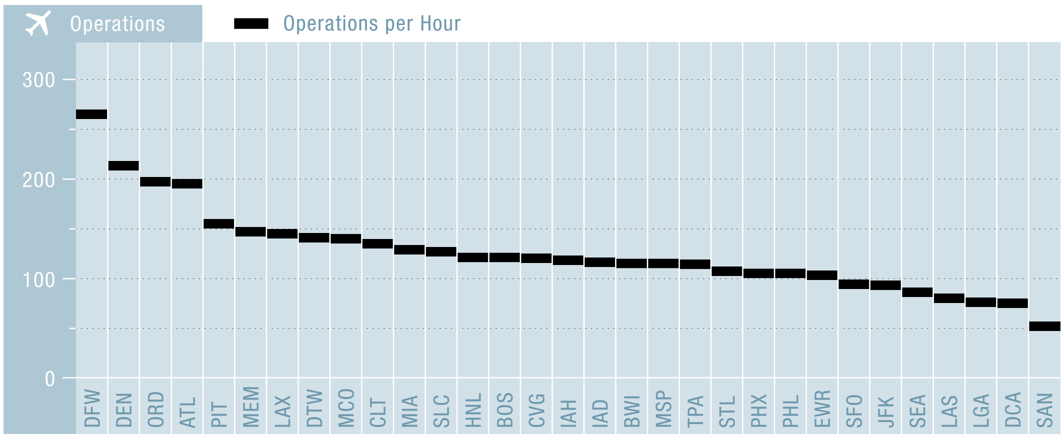
NOTES

- The optimum rate is defined as the maximum number of aircraft that can routinely be handled hourly using visual approaches during periods of unlimited ceiling and visibility.
- The reduced rate is defined as the maximum number of aircraft that can routinely be handled during reduced visibility conditions when radar is required to provide separation between aircraft.
- The published Benchmark Report shows a range for each airport's optimum and reduced rate, taking into account varying estimates by the facilities and the computer model. For simplification, only the high estimates are presented here.
- Capacity loss is the percent difference between the optimum and reduced rate.
- Percent time IFR based on meteorological conditions from 7 AM to 10 PM in CY 2000 for airport-specific ceiling and visibility criteria.
- Delays of 15+ minutes per 1000 operations from FAA OPSNET, CY 2000.

Pacing airports are highlighted

Dallas-Ft. Worth, with four parallel runways and three additional runways, has the highest optimum benchmark rate in the U.S. by a large margin, at 270 operations per hour. Denver, at 218 operations per hour, has the second highest optimum benchmark, closely followed by Chicago O'Hare at 202 and Atlanta Hartsfield at 200 (Figure 1-4).

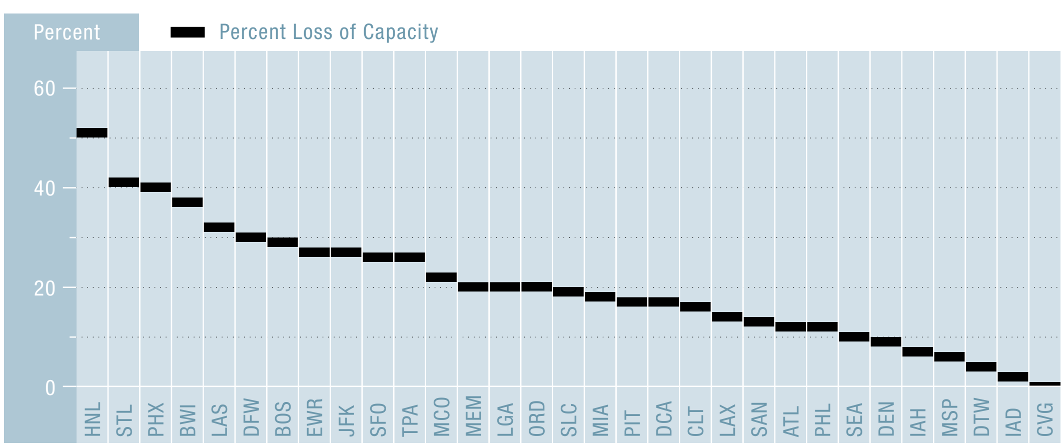
Figure 1-4 Optimum Rates for the 31 Benchmarked Airports



Significantly, while Chicago O'Hare and Atlanta Hartsfield are among the highest capacity airports in the U.S., they are also among the most delayed. In CY 2000, Chicago O'Hare had the third highest rate of delays and Atlanta Hartsfield had the eighth highest rate. Existing capacity at these airports does not appear to be sufficient to efficiently handle the high volume of traffic that they experience.

Figure 1-5 ranks the benchmarked airports by the percentage loss of capacity under reduced conditions. Denver, with five non-intersecting runways sufficiently spaced to allow three simultaneous landings in bad weather, experiences only a 10 percent reduction in operations during reduced conditions. In contrast, Boston experiences a 30 percent reduction in capacity under reduced conditions. The capacity loss at Boston is frequently caused by wind from the northwest that reduces the number of operational runways from three to two or one.

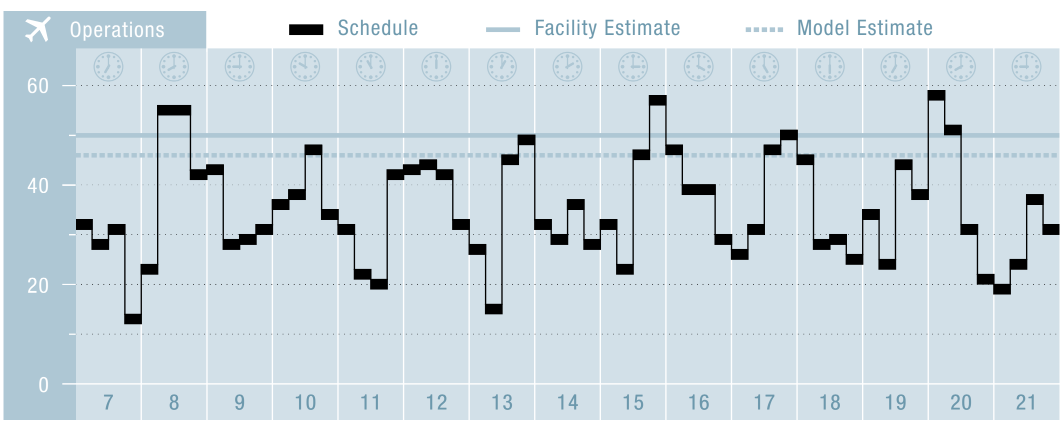
Figure 1-5 Capacity Loss During Adverse Weather at the 31 Benchmarked Airports



The effect of adverse weather on an airport's capacity depends both on the difference between the optimum and reduced benchmark rates, and the proportion of time that adverse weather occurs. For example, San Francisco, which is commonly subject to heavy fog, experiences instrument meteorological conditions approximately 26 percent of the time,[1] whereas Tampa International Airport, which typically has clear, calm weather, experiences instrument meteorological conditions approximately four percent of the time. Like San Francisco, Tampa experiences a 27 percent loss of capacity under reduced conditions. But because instrument meteorological conditions are so prevalent at San Francisco, its capacity loss over time due to adverse weather is more substantial than the loss experienced by Tampa. Further, San Francisco handles 54 percent more operations than Tampa. So not only is San Francisco more likely than Tampa to experience significant loss of capacity due to adverse weather, but also, the loss of capacity at San Francisco affects more passengers and flights.

Many of the benchmarked airports exceed their optimum and reduced rates several times per day during periods of highly concentrated arrival and departure traffic. For example, at the time the benchmarks were calculated in April 2001, scheduled operations at Atlanta Hartsfield were at or above good-weather capacity for almost two hours of the day. Figure 1-6 shows scheduled arrivals and departures and the benchmark for 15-minute intervals at Atlanta under optimum conditions. Figure 1-7 shows that under reduced conditions, capacity is lower and scheduled traffic exceeds capacity more than five hours of the day.[2]

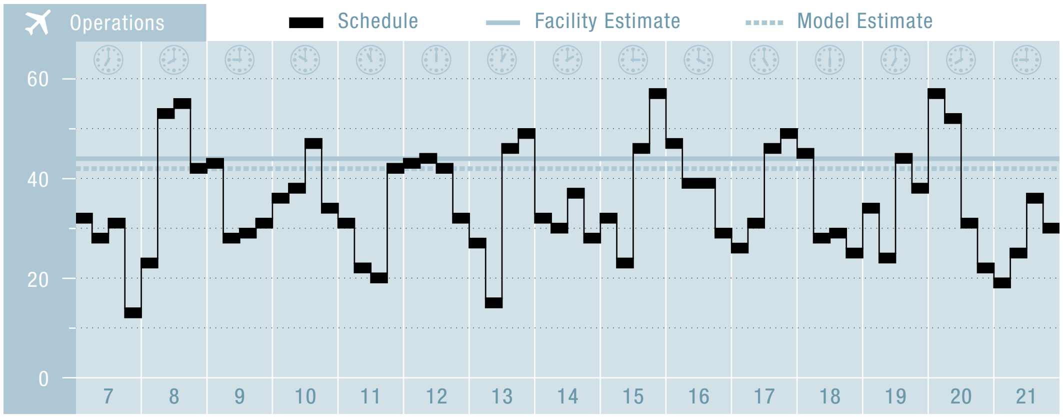
Figure 1-6 Scheduled Operations and Optimum Rate Boundaries – Atlanta Hartsfield International



1 For the purposes of this discussion, the percent of time the airport operates under instrument flight rules was used as a proxy for percent of time operating under reduced conditions.

2 Scheduled carrier operations constitute a significant part, but not all, of an airport's traffic. General aviation, and military operations, non-scheduled flights, and cargo operations typically account for between 1 and 30% of the total traffic at the 31 airports studied.

Figure 1-7 Scheduled Operations and Reduced Rate Boundaries – Atlanta Hartsfield International



In contrast, traffic at certain airports rarely reaches capacity. For example, at Baltimore-Washington International (BWI) air carrier schedules are well below capacity throughout the day when the weather is good (Figure 1-8). In adverse weather, scheduled departures occasionally exceed capacity, but significant delays are infrequent (Figure 1-9). Therefore, although capacity at BWI drops by 38 percent under reduced conditions, the traffic level at BWI is such that flights can generally continue to flow efficiently even when the weather is less than ideal. BWI experienced fewer than seven delays per thousand operations in the year 2000. However, demand at BWI is projected to grow by 27 percent over the next 10 years, suggesting that capacity enhancements may be needed to keep delays to a manageable level.

Figure 1-8 Scheduled Operations and Optimum Rate Boundaries – Baltimore-Washington International

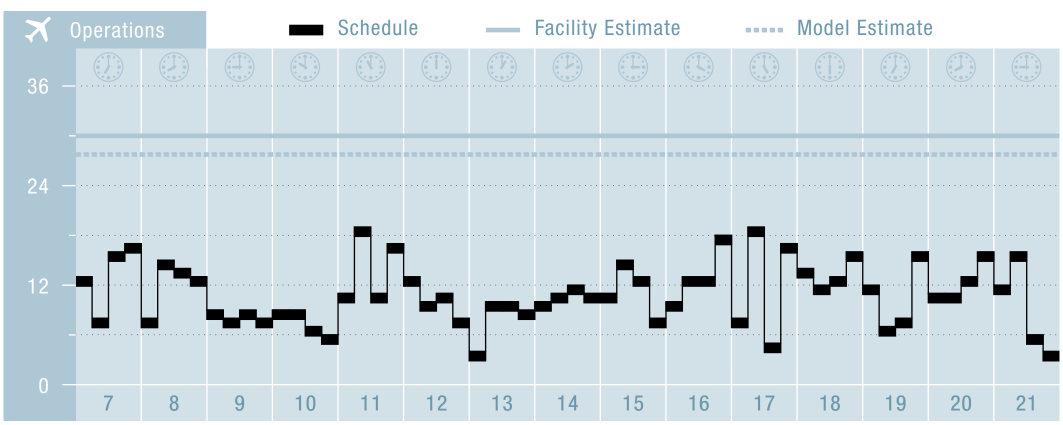
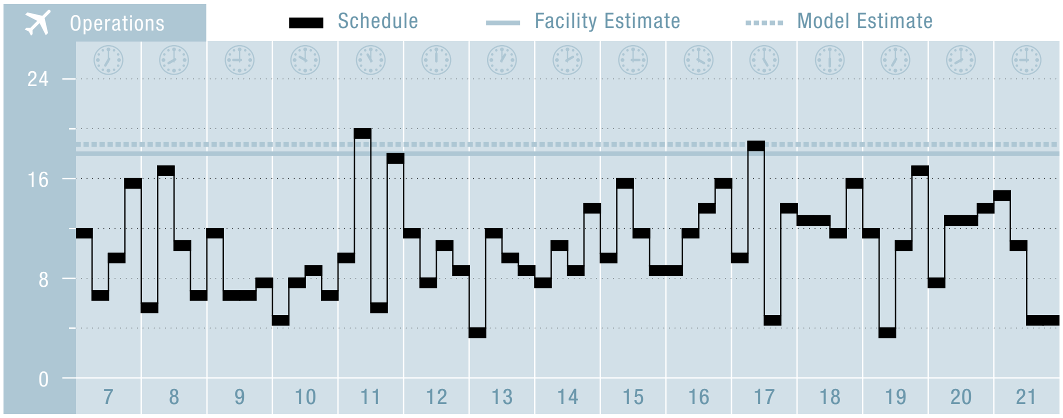


Figure 1-9 Scheduled Operations and Reduced Rate Boundaries – Baltimore-Washington International



1.3 Proposed Airport Modifications

For the past 15 years, the FAA's Office of System Capacity (ASC) has worked with airport sponsors and air traffic control facilities across the U.S. to assess alternatives for increasing airport capacity and reducing delay. ASC has conducted capacity studies at 24 of the 31 benchmarked airports, and recently developed plans to improve the operational efficiency at the eight pacing airports through a combination of airfield and terminal construction, enhanced technology, enhanced airspace design, and improved procedures. ASC is currently participating in delay reduction teams at John F. Kennedy, LaGuardia, Philadelphia, and Chicago O'Hare. Various other FAA organizations also are working to enhance capacity at the benchmarked airports. For example, the Eastern Region Capacity Enhancement Task Force, composed of representatives from the airports, airlines, and FAA regional Air Traffic and Airports divisions, meets quarterly to facilitate and coordinate short-term air traffic capacity improvements in the New York area.

The most significant airfield enhancement that an airport can make, building a new runway, is typically difficult to implement, not only because of the significant cost and time such projects require, but also because of resident opposition. Thirteen new runways are scheduled to open at the benchmarked airports between 2002 and 2007. However, only two of those runways are at the eight pacing airports. A fifth parallel runway at Atlanta, expected to open in 2005, will result in a significant increase in capacity. A runway at Boston, expected to open in 2005, would help to reduce delays in adverse weather, but is not expected to increase the capacity of the airport. Additional airports, such as Chicago O'Hare and San Francisco are considering new runways, but their plans have not advanced to the point where their impact can be estimated. Figure 1-10 shows the runway projects that are planned at the 31 benchmarked airports.

Figure 1-10 Runway Projects at the 31 Benchmarked Airports

Airport (ID)	Runway	Date	Capacity Improvement (Percent) VFR	IFR
Phoenix Sky Harbor International (PHX)	7/25	Operational–2000	36%	60%
Detroit Metro Wayne County (DTW)	4/22	Operational–2001	25%	17%
Denver International (DEN)	16R/34L	2003	18%	4%
Miami International (MIA)	8/26	2003	10%	20%
Houston Bush Intercontinental (IAH)	8L/26R	2003	35%	37%
Orlando International (MCO)	17L/35R	2003	23%	34%
Charlotte/Douglas International (CLT)	18W/36W	2004	18%	15%
Minneapolis-St. Paul International (MSP)	17/35	2004	40%	29%
Atlanta Hartsfield International (ATL)	9S/27S	2005	31%	27%
Cincinnati-Northern Kentucky (CVG)	17/35	2005	26%	26%
Seattle-Tacoma International (SEA)	16W/34W	2006	52%	46%
Lambert St. Louis International (STL)	12R/30L	2006	14%	84%
Dallas-Fort Worth International (DFW)	18L/36R	2007	11%	37%
Washington Dulles International (IAD)	12R/30L	2007	46%	54%

NOTE

A new runway is being added to Boston Logan International Airport (2005) to reduce delay in certain runway configurations. It is not expected to increase the capacity of the airport.

Aside from building new runways, the Benchmark Report summarizes other efforts the FAA and airports are pursuing to enhance capacity. For example, the FAA is developing area navigation (RNAV) arrival and departure routes for a variety of airports with an increased number of transition points to the en route airspace, which gives controllers more flexibility in routing aircraft and will improve benchmark rates over time. Also, near-term National Airspace Redesign initiatives to address seven specific areas of congested airspace, referred to as choke points, are expected to provide more efficient flows, greater access to overhead streams, and additional terminal airspace capacity surrounding several of the benchmarked airports. In addition, Free Flight technologies such as the traffic management advisor (TMA), which assists en route controllers in managing traffic flow to selected major airports, and the passive final approach spacing tool (pFAST), which assists controllers in sequencing aircraft and making runway assignments on approach, are expected to result in more efficient use of runway capacity. Further, several airports with closely spaced parallel runways, such as San Francisco and John F. Kennedy, are exploring use of the precision runway monitor (PRM), a radar with a high-update rate combined with a monitor that provides automated alerts, to allow independent approaches to parallel runways under reduced visibility conditions.

Figure 1-11 shows the percentage increases in capacity projected for the eight pacing airports under optimum and reduced conditions over the next ten years, and the percentage change in projected operations. Of the eight airports, only at Atlanta are capacity increases projected to keep pace with traffic increases, indicating that significant delays are likely to continue at the other seven pacing airports. Summaries of the planned capacity enhancements for the eight pacing airports follow Figure 1-11.

Figure 1-11 FAA's Projected Increases in Capacity and Operations at the Eight Most Delayed Airports

Airport (ID)	New Runway (If Planned) Optimum	New Runway (If Planned) Reduced	New Technology* Optimum	New Technology* Reduced	New Runway Plus New Technology** Optimum	New Runway Plus New Technology** Reduced	2010 Projected Growth in Operations
Atlanta Hartsfield International (ATL)	31	27	5	7	37	34	28
Philadelphia International (PHL)	–	–	17	11	17	11	23
New York LaGuardia (LGA)	–	–	10	3	10	3	17
Newark International (EWR)	–	–	10	7	10	7	20
Chicago O'Hare International (ORD)	–	–	6	12	6	12	18
Boston Logan International (BOS)	0	0	4	4	4	4	6
New York John F. Kennedy International (JFK)	–	–	2	3	2	3	18
San Francisco International (SFO)	–	–	0	3	0	3	18

* Estimates assume that new runways (where applicable) are in place.
** Estimates include compounding effects of new runways and new technologies and are not strictly additive.

1.3.1 LaGuardia

LaGuardia, New York's smallest but most convenient commercial airport, had the highest delay rate of any airport in the U.S. in 2000. With limited space and only two, intersecting runways, capacity is insufficient to meet demand, resulting in average flight delays of more than 40 minutes in both good and adverse weather. In 2000, LaGuardia had more flights than John F. Kennedy, which has four runways. Airspace initiatives such as targeted choke point action items and the development of improved arrival and departure routes are expected to improve traffic flow in the airport vicinity in the near term. However, there is no planned airport construction that would reduce delays on the airport surface or that would materially add to airside capacity.

LaGuardia is a slot-controlled airport, meaning that the number of takeoffs and landings are limited. In April 2000 slot controls were eased to provide access to smaller carriers and improved jet service to under-served communities, and by September 2000 the number of daily operations had increased from 1,064 to more than 1,300, resulting in flight delays which accounted for 25 percent of flight delays nationwide. In response, a moratorium on new flights was imposed, and the flights that had recently been added were scaled back. Subsequently, a temporary slot lottery was instituted which limited the number of daily flights to about 1,200. The lottery is scheduled to expire in October 2002.

The FAA has proposed a combination of market-based and administrative approaches for coping with congestion at LaGuardia after the existing lottery expires. Market-based options include landing fees based on peak-hour pricing, and a phased-in auctioning of certain takeoff and landing rights. Administrative options include holding a slot lottery that gives priority to operators using larger aircraft, and variations of the current slot allocation system which would set aside certain slots for service to small communities and possibly new entrants.

The Port Authority of New York and New Jersey has begun delay reduction studies for both LaGuardia and John F. Kennedy Airports in cooperation with Capacity Enhancement Task Forces made up of representatives of the FAA, airlines, other users, and the Port Authority. As part of these studies, capacity analyses will be conducted for both airports.

1.3.2 Newark International Airport

Newark had the second highest delay rate of any airport in the U.S. in 2000. Newark's scheduled traffic meets or exceeds its good-weather capacity for three hours per day and exceeds adverse-weather capacity for 7 1/2 hours of the day. On good weather days, six percent of the flights are delayed and on adverse weather days 18 percent are delayed.

In the near term, no airport construction that would reduce delays on the airport surface or that would materially add to airside capacity is planned. However, improved arrival and departure procedures, and the implementation of choke point action items and other airspace modifications, are expected to provide more efficient flows, improved access to overhead streams, and additional terminal airspace capacity. In addition, Newark is a good candidate for using a PRM to allow simultaneous offset instrument approaches to its parallel runways, which are spaced 900 feet apart.

The Port Authority of New York and New Jersey, airlines, and FAA's Office of System Capacity worked together on a Capacity Enhancement Plan for Newark, which was published in 2000. This study examined the delay reduction potential of additional runway and related infrastructure improvements and recommended a number of capacity enhancements at Newark for further study.

1.3.3 Chicago O'Hare

Chicago O'Hare had the third highest delay rate of any airport in the U.S. in 2000. Chicago's scheduled traffic meets or exceeds its good weather capacity for 3 1/2 hours of the day and exceeds its adverse-weather capacity for eight hours of the day. On good weather days about two percent of the flights are delayed and on adverse weather days 12 percent of the flights are delayed.

O'Hare's seven runways allow more than 2,500 operations per day, but because nearly all of the runways intersect one or more of the others, during periods of limited visibility planes are permitted to land only at two non-intersecting runways. The restriction of land-and-hold-short operations (LAHSO), a procedure that permits simultaneous operations on intersecting runways, at O'Hare in 1999, resulted in a reduction of 36 to 40 operations per hour in one of the most commonly used runway configurations.

Planned airport construction at O'Hare will reduce delays on the airport surface but will not materially add to airside capacity. The World Gateway program will reduce delays due to gate congestion by adding 20 to 30 gates, and improve circulation on the airport surface through taxiway extensions and modifications.

No new runways for O'Hare are in the advanced planning stages. However, the mayor of Chicago recently proposed adding two runways at the airport, which could allow the number of flights to increase by 50 percent and alleviate the substantial delays that currently plague the airport. The proposed runways would allow simultaneous operations in reduced visibility.

The FAA is participating on the O'Hare Delay Task Force to identify near- and long-term solutions to the problems of flight delays at the airport. The task force will address technology improvements, air traffic procedures, and airline decision making during inclement weather. The task force is expected to release a report with recommendations by the spring of 2002.

1.3.4 San Francisco International Airport

San Francisco had the fourth highest delay rate of any airport in the U.S. in 2000. San Francisco's current scheduled traffic can be handled efficiently during good-weather conditions, but scheduled traffic exceeds adverse-weather capacity for more than five hours of the day. On average, six percent of flights are delayed 15 minutes or more, but in adverse weather this escalates to 17 percent.

A new international terminal that opened in December 2000 is helping to reduce gate delays. In addition, new taxiways and high-speed turnoffs will improve runway utilization and may thereby improve airside capacity. In IFR conditions, San Francisco is limited to a single arrival stream to its closely spaced parallel runways, which significantly reduces throughput. The airport recently purchased a PRM for the purpose of allowing dual arrival streams in IFR conditions. The final safety analyses for conducting simultaneous offset instrument approaches to its parallel runways are underway. In the longer term, San Francisco proposes to significantly revise its runway configuration. One proposal to increase the spacing between its parallel runways to allow dual arrival streams in bad weather would require filling in portions of San Francisco Bay.

1.3.5 Boston Logan International Airport

Boston had the fifth highest delay rate of any airport in the U.S. in 2000. Boston's scheduled traffic can be handled efficiently during good-weather conditions, but scheduled traffic exceeds adverse-weather capacity for 8 hours of the day. On adverse weather days, about 12 percent of the flights are delayed versus four percent on good weather days. The loss of LAHSO in 1999 at Boston resulted in eight fewer operations per hour in one of the most commonly used runway configurations.

Massport is proposing a new runway to open in 2005. It will not affect the Boston capacity benchmarks, but will help mitigate delays currently encountered during Northwest wind conditions when the airport is currently reduced to a dual or a single runway operation. Terminal construction will reduce gate contention delays, and new taxiways and high-speed turnoffs will improve runway utilization, thereby minimally improving airside capacity.

1.3.6 Philadelphia International Airport

Philadelphia had the sixth highest delay rate of any airport in the U.S. in 2000. Philadelphia's scheduled traffic peaks can be handled efficiently during good-weather conditions, but scheduled traffic exceeds adverse-weather capacity for 3 1/2 hours of the day. On adverse weather days, about 14 percent of the flights are delayed.

A new parallel commuter runway was opened at Philadelphia in 2000. No additional new runways are currently planned. However, terminal construction will reduce delays due to gate congestion, and new taxiways and high-speed turnoffs will improve runway utilization and may thereby improve airside capacity. Use of the recently commissioned PRM for simultaneous operations to the two main runways during periods of reduced visibility offers the potential for further increases in operational flexibility and airport capacity. The airport is in the process of a significant master planning effort, which is focused on the airfield.

1.3.7 New York John F. Kennedy International Airport

John F. Kennedy had the seventh highest delay rate of any airport in the U.S. in 2000. John F. Kennedy's scheduled traffic peaks can be handled efficiently during good-weather conditions, but scheduled traffic exceeds adverse-weather capacity for more than 5 hours of the day. On adverse weather days, about 9 percent of the flights are delayed.

In the near term, there is no planned airport construction that would reduce delays on the airport surface or that would materially add to airside capacity. However, the Port Authority of New York and New Jersey has begun a delay reduction study in cooperation with the FAA, airlines, and other airport users. Possible airport enhancements include instrument landing system (ILS) upgrades, re-introduction of LAHSO procedures, exit taxiway improvements, and a runway extension. In addition, modifications to airspace, such as the creation of new sectors, will result in more efficient routing and reduced interactions between aircraft to and from other airports in the region. The Benchmark Report estimates that procedural, airspace, and technology improvements only improve good-weather capacity by two percent and adverse-weather capacity by three percent over the next 10 years.

1.3.8 Hartsfield Atlanta International Airport

Atlanta had the eighth highest delay rate of any airport in the U.S. in 2000. Even when the weather is good, scheduled traffic at Atlanta meets or exceeds its good-weather capacity for almost two hours per day. During adverse weather, scheduled traffic exceeds adverse-weather capacity for more than eight hours of the day. As a result, on good weather days, about three percent of the flights are delayed, and on adverse weather days six percent of the flights are delayed.

A new runway, planned for completion in 2005, is expected to improve Atlanta's capacity benchmark by 31 percent in good weather and by 27 percent in adverse weather.[3] Additional taxiways and high-speed turnoffs, plus terminal construction will reduce gate contention delays and improve runway utilization.

New arrival and departure routes will improve efficient traffic flow and increase the benchmarks further. In addition, the use of a PRM could potentially allow triple simultaneous approaches.

1.4 Reaction to the Benchmarks

The Airport Capacity Benchmark Report has been recognized as an important step in understanding the relationship between airline demand and airport capacity. The FAA, airports, and airlines have already begun to use the benchmarks to target and address system inefficiencies and limited capacity. Even before the benchmarks were published, several airlines began to modify their schedules to help reduce delays at their hubs. For example, in Atlanta, Delta began to spread its flights more evenly across the day, reducing the number of flights per bank but adding two additional banks. The change resulted in fewer flights at peak times, but more arrivals and departures overall and fewer delays.

3 According to one estimate the new runway could increase capacity in IFR conditions by as much as 50 percent if triple independent IFR approaches using a PRM can be conducted.

United Airlines began running fewer flights among its five hubs, but using the larger planes to carry more passengers on each trip.

The FAA, Congress, and various airports are also considering demand management strategies such as additional slot limitations, limited antitrust immunity for airlines to allow coordinated scheduling, and peak hour pricing as supplements to ongoing capacity enhancement strategies. In addition, efforts are underway to streamline the process of planning and constructing runways by reducing the amount of time required for environmental analyses, and modifying the process to allow concurrent, rather than sequential, accomplishment of key milestones.

Coordinated actions at the Federal, State, and local level, and focus of purpose will be required to increase the capacity of the aviation system and reduce flight delays. The benchmarks are one tool to let us know how much work remains to be done.

2

NATIONAL AIRSPACE SYSTEM PERFORMANCE AND AVIATION ACTIVITY

This chapter contains a discussion of the performance of the National Airspace System and includes statistics describing current and projected aviation activity at U.S. airports. It summarizes developments in aviation services that may lead to an increase in aviation activity in the future.

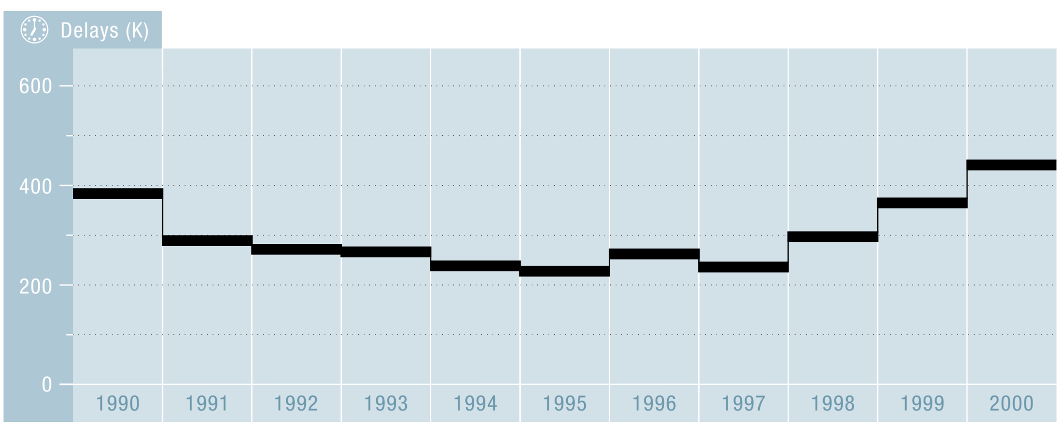
2.1 System Performance

Delay is the traditional measure of NAS performance. However, delays are only a summary measure of the interactions among capacity and demand at airports and in airspace throughout the system. During a given hour, if aircraft using an airport sought service at a continuous rate equal to that at which aircraft operations could be processed, and if operating conditions at the airport were constant throughout the hour, then operations could reach the airport's highest capacity without significant delays. However, the rate at which aircraft arrive and depart is never continuous. There are periods during an hour when several aircraft demand service at the same time and periods when none arrive or depart. Therefore, the number of operations an airport actually processes usually is less than the airport's highest capacity, even when the weather is favorable. As demand approaches airport capacity, some delays related to congestion will occur. However, if demand begins to exceed airport capacity, delays will become more significant and occur at an increasing rate.

2.1.1 Delays Reported by the Operations Network

The FAA reports the delay performance of the NAS every month, using data from its Operations Network (OPSNET). These data come from observations by FAA personnel, who record only aircraft that are delayed by 15 minutes or more during any phase of flight. According to OPSNET data, 450,289 flights were delayed 15 or more minutes in CY 2000, an increase of 20.3 percent over the 374,116 flight delays in CY 1999. Figure 2-1 shows flight delays for the years for which OPSNET data are available.

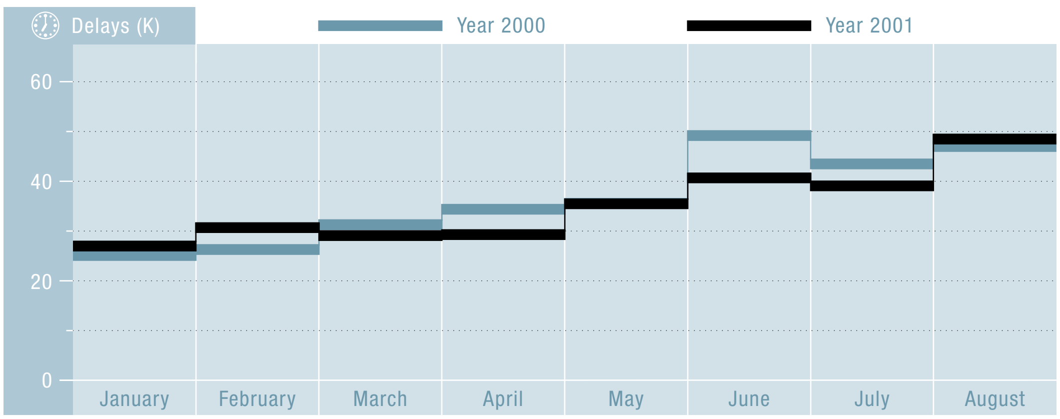
Figure 2-1 Annual Flight Delays CY 1990-CY 2000



4 Congress has directed the FAA and the Department of Transportation's Bureau of Transportation Statistics (BTS) to develop a common system for reporting delays. The FAA and BTS have agreed upon a common definition of delay: a flight will be considered delayed if it arrives at the destination gate 15 minutes or more after its scheduled arrival time. However, the system to track delays using this definition is not yet in place. The 2002 ACE Plan will report on these changes and provide data on delays from the new measurement system.

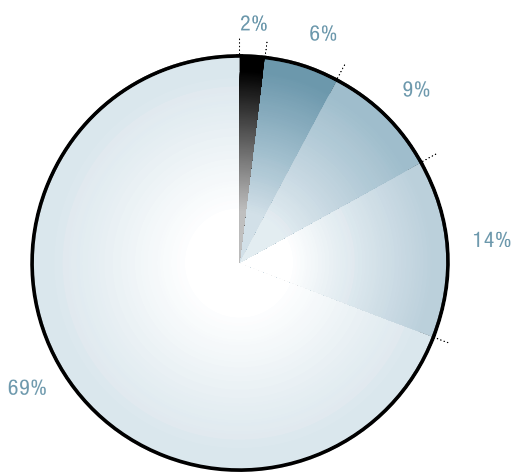
However, the negative trend of recent years was reversed in 2001. Not only have the double-digit increases in delays stopped, but beginning in March 2001 the number of delays declined for every month except August. From April – June 2001, delays declined by 11.21 percent compared to the same period in the previous year. During June, July, and August, when convective weather disrupts many operations, delays were down by 7.99 percent from the previous summer. The FAA attributes these improvements to the efforts of the airports, the airlines, and the FAA to address airport and airspace congestion, as well as a slight improvement in the weather during the summer. Figure 2-2 shows the number of delays, by month, from January through August 2000 with comparable data for 2001. For the eight month period, delays declined by 4.16 percent.

Figure 2-2 Delays By Month, January-August 2000 and 2001



One of the most valuable aspects of the OPSNET system is that it attributes each delay to one of several causal factors: weather, traffic volume, NAS equipment outages, closed runways, and other causes. The primary causes of delay have varied little year over year, with a large majority of delays attributed to weather (from 65 to 75 percent) and a smaller but significant percentage to traffic volume (12 to 22 percent.) Figure 2-3 shows the distribution of delays by cause for CY 2000.

Figure 2-3 Flight Delays by Cause CY 2000



2%	Equipment
6%	Runway
9%	Other
14%	Volume
69%	Weather

2.1.2 The Aviation System Performance Metrics System

The FAA is developing a new delay measurement system in cooperation with the Department of Transportation and the airlines called the Aviation System Performance Metrics (ASPM) system. This system will replace the Consolidated Operations and Delay Analysis System (CODAS) system, which has been discussed in the ACE Plan in recent years.

In November 1999, the FAA, the Air Transport Association and a number of air carriers agreed to share data so that a common set of performance metrics could be computed. The participants agreed that the metrics would be made available without any attempt to assign causality. Currently, 49 airports comprise the ASPM system.

Ten large air carriers have agreed to provide actual flight times directly to the FAA through ARINC, a private aviation services company, every day. The times on an individual flight that will be provided are the Out, Off, On and In times (OOOI), which are defined as:

- Out is the time that the aircraft departs the gate
- Off is the time that the aircraft departs the runway
- On is the time that the aircraft touches down at the arrival airport runway
- In is the time that the aircraft arrives at the gate

Flight times for four other air carriers are added to the ASPM database once a month, using data that are reported to the Department of Transportation's Bureau of Transportation Statistics. Flight times for all other carriers are estimates. For each individual flight, the OOOI data are merged with data from the FAA's Enhanced Traffic Management System (ETMS) and the Official Airline Guide and are used to compute a number of metrics. The ASPM system is still in development, so the metrics are not yet available to the public. The FAA expects to complete the system in the near future and will then release the metrics each day.

2.2 Aviation Activity in the United States

Aviation activity is the most appropriate measure of demand on airports and air traffic service providers. Aviation activity in the United States comes from a number of diverse participants: large commercial air carriers, regional carriers, on-demand air taxis, commuter airlines, all-cargo airlines, the military, and general aviation operators. These users place different demands upon the airports and air traffic control system, because the magnitude, the distribution, the location and the timing of their activities vary. All commercial activity is conducted under the control of the FAA's air traffic control system, whether the operators are large commercial jets, regional jets, cargo carriers, commuters, or air taxis.

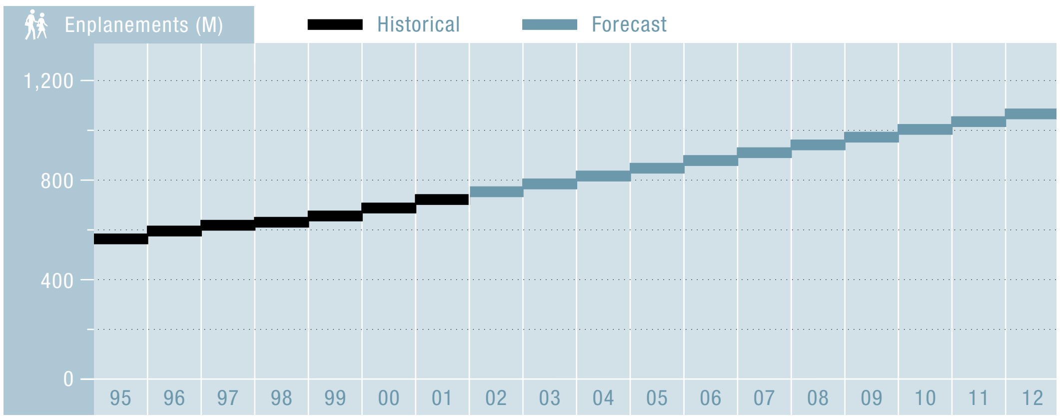
In contrast, the majority of general aviation (GA) activity takes place at small airports far from major urban centers and has little or no contact with the air traffic control system. Much of the contact that GA pilots do have is with the specialists at flight service stations rather than with controllers. Military airfields support most of the military activity and the military's own air traffic control system.

As activity increases, this puts increased pressure on airports and the air traffic control system to provide safe and efficient services. When demand exceeds capacity, either in airspace or at airports, flight operations are disrupted and passengers are delayed.

2.2.1 Passenger Enplanements and Aircraft Operations at U.S. Airports

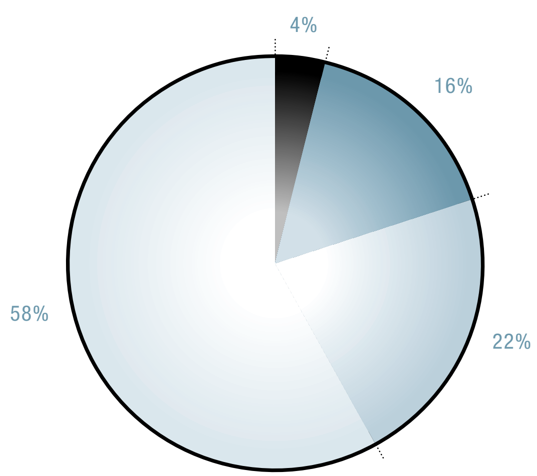
In FY 2000, passenger enplanements grew by 4.4 percent over the previous year, from 666.2 million to 695.7 million, approaching the 700 million levels for the first time.[5] The FAA forecasts that enplanements will top one billion in FY 2010 and reach 1.084 billion in FY 2012, an increase of 55.8 percent over today's level. Figure 2-4 shows the growth in passenger enplanements from FY 1995 and the FAA forecasts for FY 2001 through FY 2012.

Figure 2-4 Passenger Enplanements FY 1995-FY 2012



Passenger enplanements apply only to commercial operations, but the FAA tracks aircraft operations for four classes of users that conduct operations at U.S. airports: air carriers, air taxis/commuters, general aviation, and the military. Figure 2-5 shows aircraft operations by user group for FY 2000. General aviation operators accounted for the large majority of aircraft operations, with air carrier and air taxi/commuters accounting for most other operations. Military operations made up a small fraction of aircraft operations.

Figure 2-5 Aircraft Operations by User Group FY 2000

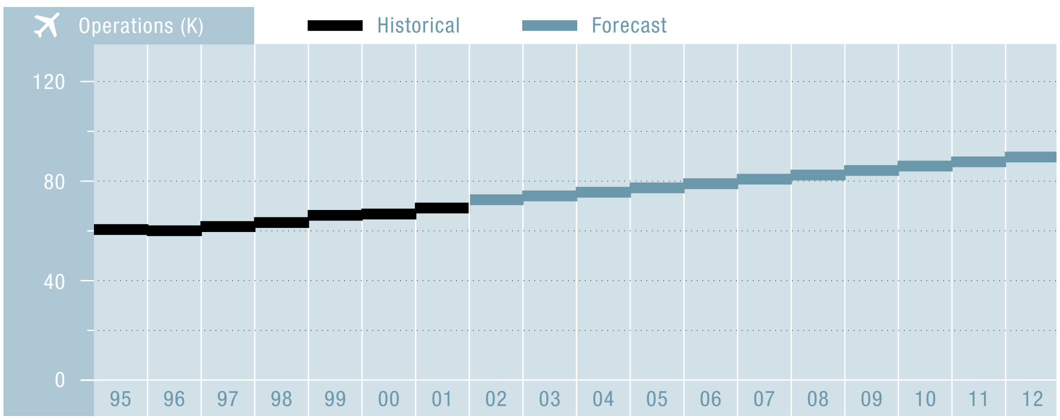


4%	Military
16%	Air Taxi/Commuter
22%	Air Carrier
58%	General Aviation

5 The ACE Plan generally uses fiscal year (FY) numbers for enplanements and operations so that they can be compared with the FAA's forecasts, which are available only for fiscal years. The data in this section and in the accompanying tables are from the FAA Aerospace Forecasts 2001-2012, March 2001, Table 11, and some data have been updated by the Office of Aviation Policy and Plans, Statistics and Forecast Branch.

Aircraft operations for all users increased slightly in FY 2000, rising from 68.1 million to 68.7 million operations. However, the rates of growth for the four user groups varied significantly: air carrier operations increased by 3.94 percent and air taxi/commuter operations increased by 1.75 percent, while general aviation operations decreased by 0.48 percent and military operations decreased by 1.12 percent. The FAA forecasts aircraft operations to increase significantly in the future, reaching 91.5 million for all users in FY 2012, an increase of 33.2 percent over today's level. Figure 2-6 shows the growth in aircraft operations, for all users, from FY 1995 through FY 2000 and FAA forecasts from FY 2001 through FY 2012.

Figure 2-6 Aircraft Operations, All Users FY 1995-FY 2012



The projected growth rate for aircraft operations differs for the various user groups. For the 12-year period, the FAA forecasts air carrier operations to increase by 43.6 percent, substantially faster than the overall rate.

2.2.2 Enplanements and Operations at the 100 Busiest Airports

Because of the concentration of commercial traffic at the largest airports and the dispersion of general aviation operations, the 100 busiest airports, as ranked by passenger enplanements, accounted for more than 96 percent of passenger enplanements but only 42 percent of aircraft operations in FY 2000. The number of passenger enplanements at the 100 busiest airports increased from 634.8 million in FY 1999 to 650 million in FY 2000, a 2.4 percent increase. In the same period, aircraft operations at those 100 airports increased by 3.2 percent, from 18.5 to 19.1 million. The FAA forecasts that enplanements at those airports will grow to 1.049 billion and that operations for all user groups will increase to 28 million by FY 2012.

Passenger enplanements for the 100 busiest airports (ranked by CY 2000 enplanements), by both fiscal and calendar year for the past three years are shown in Appendix B-1. The FAA forecasts and rates of growth for these same airports for FY 2012 are presented in Appendix B-2. Aircraft operations for all user groups for the same 100 airports (ranked by CY 2000 enplanements), by both fiscal and calendar year for the past three years are shown in Appendix B-3. The FAA forecast and rates of growth for those airports for FY 2012 are presented in Appendix B-4.

2.2.3 General Aviation Activity

General aviation (GA) includes all segments of the aviation industry except commercial air carriers and the military. The majority of U.S. airports handle only GA traffic. Many of these are small rural airports; flights to and from those airports have little or no contact with the FAA's air traffic control system and don't affect airspace or airport capacity. However, in FY 2000, there were almost 40 million GA operations recorded at airports with FAA and contract towers, well over 50 percent of total aircraft operations. These aircraft operations did use the air traffic control system and added to the mix of traffic at those airports.

Figure 2-7 lists the airports with FAA and contract towers with the largest number of general aviation aircraft operations. Six of these airports are primary commercial service airports, while four are relievers, general aviation airports designated to provide an alternative to commercial service airports in major metropolitan areas.

Figure 2-7 Airports With The Most General Aviation Operations FY 2000

Airport (ID)	City/State	Airport Type	Operations	Based Aircraft
Van Nuys (VNY)	Van Nuys, CA	Reliever	518,682	812
Daugherty Field (LGB)	Long Beach, CA	Primary	392,747	426
Denver Centennial (APA)	Denver, CO	Primary	382,443	702
Orlando Sanford (SFB)	Orlando, FL	Primary	363,268	299
Daytona Beach (DAB)	Daytona Beach, FL	Primary	358,425	184
Phoenix-Deer Valley (DVT)	Phoenix, AZ	Reliever	343,933	835
Oakland-Pontiac (PTK)	Pontiac, MI	Reliever	336,091	816
E.A. Love Field (PRC)	Prescott, AZ	Primary	325,061	323
Meacham International (FTW)	Ft. Worth, TX	Reliever	318,566	442
John Wayne (SNA)	Santa Ana, CA	Primary	312,627	651

General aviation also has a significant presence at the largest commercial service airports. Figure 2-8 shows that GA traffic accounted for 9.83 percent of total aircraft operations at the thirty-one large-hub airports in FY 2000. The actual percentages of general aviation operations varied from just 1.25 percent at Seattle-Tacoma to 30.58 percent at Ft. Lauderdale.

Figure 2-8 GA Activity at Large-Hub Airports in FY 2000

Airport (ID)	General Aviation Operations	Total Operations	% General Aviation Operations
Ft. Lauderdale-Hollywood International (FLL)	87,787	287,094	30.58
Honolulu International (HNL)	89,510	343,296	26.07
Minneapolis-St. Paul international (MSP)	128,497	524,261	24.51
Las Vegas McCarran International (LAS)	119,100	535,935	22.22
Salt Lake City International (SLC)	81,312	369,343	22.02
Phoenix Sky Harbor International (PHX)	116,389	624,261	18.64
Ronald Reagan National (DCA)	60,255	344,092	17.51
Tampa International (TPA)	47,002	277,888	16.91
Miami International (MIA)	78,379	516,009	15.19
Washington Dulles International (IAD)	62,003	495,717	12.51
Detroit Metropolitan Wayne County (DTW)	69,154	561,123	12.32
Philadelphia International (PHL)	58,802	484,963	12.13
Charlotte/Douglas International (CLT)	55,241	458,697	12.04
Baltimore-Washington International (BWI)	34,012	309,535	10.99
Orlando International (MCO)	32,727	367,367	8.91
San Diego International Lindberg Field (SAN)	16,713	208,894	8.00
Newark International (EWR)	18,285	458,677	6.99
Boston Logan International (BOS)	33,921	510,113	6.65
Greater Cincinnati International (CVG)	32,160	485,001	6.63
San Francisco International (SFO)	28,061	437,763	6.41
Greater Pittsburgh International (PIT)	25,522	449,168	5.68
George Bush International (IAH)	27,081	483,806	5.60
Dallas-Fort Worth International (DFW)	47,241	875,673	5.39
Lambert St. Louis International (STL)	23,730	489,529	4.85
New York LaGuardia (LGA)	17,472	378,018	4.62
New York John F. Kennedy International (JFK)	12,561	358,977	3.50
Chicago O'Hare International (ORD)	28,162	906,326	3.11
Denver International (DEN)	15,565	520,882	2.99
Hartsfield Atlanta International (ATL)	25,285	922,016	2.74
Los Angeles International (LAX)	18,438	781,418	2.36
Seattle-Tacoma International (SEA)	5,576	444,630	1.25
Total Large-Hub Airports	**1,495,943**	**15,210,472**	**9.83**

2.2.4 Air Cargo Activity

There are two types of air cargo carriers: combination carriers that carry passengers in the main body of the aircraft and freight in the belly (along with passengers' baggage) and all-cargo carriers that transport freight but do not carry passengers. The FAA has forecast that air cargo traffic would grow at 5.7 percent annually from FY 2000 through FY 2012. Cargo traffic tends to track economic activity and future traffic is expected to follow the recovery of the economy.

Figure 2-9 shows the amount of cargo loaded and unloaded, in thousands of metric tons, at the ten busiest airports for the past three calendar years, rank by CY 2000 tonnage, and the percentage change from 1999 to 2000.

Figure 2-9 Cargo Loaded and Unloaded at the Ten Busiest Airports CY 2000 (thousands of metric tons)

Airport (ID)	1998	1999	2000	% Change Over 1999
Memphis International (MEM)	2,369	2,412	2,489	3.2
Los Angeles International (LAX)	1,861	1,969	2,039	3.6
John F. Kennedy International (JFK)	1,604	1,728	1,818	5.2
Anchorage International (ANC)	1,289	1,657	1,804	8.9
Miami International (MIA)	1,793	1,651	1,643	(0.8)
Louisville International (SDF)	1,395	1,440	1,519	5.5
Chicago O'Hare International (ORD)	1,402	1,481	1,469	(0.8)
Indianapolis International (IND)	813	1,041	1,165	11.9
Newark International (EWR)	1,094	1,093	1,082	(1.0)
Dallas/Ft. Worth International (DFW)	N/A	830	905	9.0

Source: Airports Council International – North America

2.3 Other Sources of Aviation Activity

The FAA forecasts robust growth for all current sources of aviation activity. In addition, a number of developments in the aviation industry may have a long-term impact on the demand for airport and airspace capacity. These include the continuing growth in the use of regional jets, the development of new large aircraft and the proposed development of the Boeing sonic cruiser. Each of these is discussed in the following section.

2.3.1 Update on Regional Jets

During 2000, regional jets continued to be one of the most dynamic sectors of the aviation industry. Most aviation analysts and the FAA expect the size of the regional jet fleet, the number of regional jet operations, and the number of airports they serve to grow rapidly.

In FY 2000, the regional airlines enplaned 79.6 million passengers. The FAA projects that regional carrier's system-wide enplanements (which includes both turboprop and jet operations) to increase by 5.6 percent annually through FY 2012. Growth in regional jet enplanements and operations may be substantially higher at some airports because of local circumstances, such as the construction of new runways and shifting airline schedules.

Most of regional carriers' growth will come from an increase in the use of regional jets. The proportion of the regional carriers' traffic provided by regional jets continues to increase as they jets replace turboprops and as larger regional jets, with seating capacity exceeding 50, are introduced. The increased use of regional jets is also expected to increase the average seating capacity of the regional fleet and the average passenger trip length for these carriers. The FAA forecasts that the number of regional jets in service will increase from 569 in FY 2000 to 2,190 in FY 2012.

2.3.2 New Large Aircraft

Airbus is building a new large aircraft (NLA) called the A380, which will have a minimum of 555 seats and a range of 8,000 nautical miles. The first passenger A380 is expected to go into operation in 2006, with the cargo version, the A380-800F, following in March 2008. To date, seven non-U.S. carriers have placed orders for passenger and freighter aircraft, while one U.S. carrier has ordered freighters. Airbus predicts that 360 A380s will be in service by 2009 and another 1,235 by 2019. In recognition of the potential benefits of using fewer but larger aircraft to transport passengers, the FAA is actively engaged in determining the structural and operational changes that will be required to accommodate NLAs at U.S. airports. The FAA's NLA Facilitation Group, composed of representatives from the FAA, aircraft manufacturers, airports and various aviation industry associations, has been evaluating such issues as airport design standards, airport rescue and firefighting requirements, and wake vortex separation standards.

Airports with at least two daily Boeing 747 flights are the most likely candidates for early A380 service. These include New York Kennedy, Miami, Los Angeles, and San Francisco. In addition, Memphis is a likely early A380 airport, since FedEx, which has its hub there, has ordered a number of A380 freighters.

In 1970, the FAA upgraded its airport standards and guidance materials to accommodate the Boeing 747, which was larger than other aircraft in operation at that time. Now, thirty years later, the development of NLAs has caused airport design standards to come under scrutiny again. Only a few U.S. airports have been built to, or have had a portion of their airfield built to Design Group VI standards, capable of handling large aircraft such as the A380.

In 1998, the Airports Council International-North America surveyed the major U.S. airports regarding the construction costs of bringing NLAs to their airports. Los Angeles and New York Kennedy, two of the likely candidates for early A380 service, each estimated that it would cost more than $100 million to make the runway and taxiway modifications necessary to accommodate NLAs using current Design Group VI standards. Terminal and apron modifications would push the costs even higher. Accommodating the A380 at Design Group V airports would require additional modifications, such as restricting traffic on adjacent runways or taxiways.

In addition, the high second deck of the A380 presents logistical difficulties under existing aircraft rescue, fire fighting and other emergency procedures. The FAA is reviewing current provisions of Federal Aviation Regulation Part 139 that address these procedures. Finally, because wake vortex effects are generally proportional to aircraft weight, the A380 will produce greater wake vortices than existing aircraft, requiring a modification in separation standards for following aircraft. The FAA has proposed that the manufacturers conduct studies to determine the wake vortex characteristics of NLAs.

2.3.3 Sonic Cruisers

Boeing forecasts a much smaller market for NLAs than Airbus and has dropped its plans for such an aircraft. Instead, Boeing is developing a smaller but faster aircraft dubbed the "sonic cruiser," which is targeted at point-to-point markets rather than the large hub airports that are the focus of the A380 effort.

The sonic cruiser will seat between 100 and 300 passengers and fly at speeds from Mach .95 to Mach .98, or 95 to 98 percent of the speed of sound (the speed of sound varies by altitude and temperature, so Mach percentages are more accurate; it is 740 miles per hour at sea level and 59 degrees Fahrenheit). The sonic cruiser will also fly at higher altitudes than current jets, cruising above 40,000 feet. A near-sonic jet would not produce the loud sonic booms that result when jets exceed the speed of sound.

The fastest subsonic jetliner in operation is the Boeing 747-400, which has a cruise speed of Mach .85, about 560 miles per hour at 35,000 feet. Boeing estimates that the sonic cruiser will reduce travel times by about an hour for every 3,000 miles flown, an improvement of 10 to 15 percent. This would result in a time savings of 50 minutes on a New York-London flight, typically seven hours now, and as much as 115 minutes on a Singapore-London flight, about 14 hours now. Boeing has said that the new aircraft could be produced as soon as 2007.

3

AIRPORT CAPACITY, ANALYSIS AND ENHANCEMENTS

This chapter contains an update of the airport-specific capacity studies supported by the FAA Office of System Capacity, an overview of airport development and the phases required for new runway construction, and recent initiatives to improve the project development process. It concludes with a summary of numerous capacity enhancement projects underway at the top 100 U.S. airports.

3.1 Airport Capacity Analysis

Capacity analysis is a complex process. The number and placement of runways and taxiways, the types of navigation aids, and the types of air traffic control equipment and facilities determine airport capacity. But other variables such as aircraft performance, the mix of aircraft types, pilot proficiency, weather, and runway closures affect how much of an airports capacity can be used at a given time. The capacity in use is often less than the capacity that would be available if there were no such limitations. In addition to the Airport Capacity Benchmark Report highlighted in Chapter One, the FAA's Office of System Capacity (ASC) is involved in many other efforts to analyze and improve the performance of our nations airports.

ASC is part of the FAA's Air Traffic Services (ATS) organization. The mission of ATS is to serve its customers and work proactively to meet their needs by directing, coordinating and ensuring the safe and efficient utilization of the (NAS) In support of this mission, ASC improves system efficiency by identifying and evaluating initiatives with the potential to increase capacity in the NAS. Among its many responsibilities, ASC supports Airport Capacity Design Teams. These teams evaluate alternatives for increasing capacity at specific airports that are experiencing or projected to experience significant flight delays. Capacity studies are a crucial element in attaining funding for airport development projects. ASC also serves on teams investigating other airport capacity enhancements and participates in air traffic control simulations at the request of local and regional Air Traffic representatives and foreign airport operators.

3.2 Airport Capacity Design Team Studies

A typical Airport Capacity Design Team includes FAA representatives from ASC, Air Traffic, the Technical Center and the Office of Airports for the appropriate region, and representatives from the airport operator, airlines, and other aviation interests. Design Team members propose actions to improve airport capacity and the FAA Technical Center's NAS Advanced Concepts Branch conducts computer simulations of the most promising alternatives. The output of the simulation is an analysis of the impact of each alternative on the operation of the airport.

Upon completion of its study, the Airport Capacity Design Team issues a Capacity Enhancement Plan (CEP) that presents a list of recommended actions and estimates of the impact of each alternative on delays at that airport. Because of possible changes in airport activity forecasts and other factors incorporated in the baseline period of the initial study, recommendations frequently require additional study before they can be implemented. However, over the years, a large number of Design Team recommendations have been adopted by the airport operators, funded by the FAA and other sources, and implemented.

Over 50 Airport Capacity Design Team studies have been completed and CEPs published since 1988. Appendix C lists completed CEPs, their recommendations, and the status of those recommendations (whether they were or were not implemented). Most recently, ASC completed a study for Portland International Airport. In conjunction with the Airport Capacity Benchmark Report, ASC is also focusing on the eight most delayed airports in the U.S., referred to as pacing airports, and is also participating on the Chicago O'Hare Delay Task Force. These and other ASC projects are summarized briefly in this chapter.

3.2.1 Portland International Airport

Portland International Airport ranked 30th in aircraft operations according to the 1999 baseline data, is forecast to experience a 37.9 percent increase in operations by 2011. Based on that forecast, the Portland International Airport Capacity Design Team conducted an update of its 1996 Capacity Enhancement Plan. There were two goals of the study. The first goal was to identify and evaluate technical challenges posed by developing a third parallel runway with associated taxiways, and constructing an additional terminal or expanding the existing terminal. The second goal was to determine what capacity and delay reduction benefit, if any, a new parallel runway would provide. Operational improvements were also considered. The study was released in October 2001. The study will be published on the ASC website, and the findings will be summarized in the 2002 ACE Plan.

3.2.2 Chicago O'Hare Task Force

The Aviation Department of the City of Chicago formed the O'Hare Delay Task Force, the second team assembled since 1991, to identify the means for reducing airline delays. The task force will focus on technology improvements, air traffic procedures, and airline decision-making during inclement weather.

3.3 Additional Airport Capacity Activities

ASC is currently a participant in capacity-enhancement projects involving Dallas/Fort Worth International, Baltimore-Washington International and Washington Dulles International airports.

3.3.1 Dallas/Fort Worth International Airport

As of the baseline study period of July 1999, regional jets represented just five percent of the commuter fleet at Dallas/Fort Worth International Airport. The FAA forecasts their numbers to increase significantly as turboprops are replaced, placing additional demand on current jet runways and route structures.

The DFW Airfield Capacity Design Team is currently conducting Phase III of its Airfield Capacity Enhancement Study, a RJ Impact Assessment, to estimate the effect of increased RJ operations under existing airport procedures. The assessment showed an increase in departures on runways 18L and 17R, leading to taxi-in delays for arriving aircraft and taxi-out and ground delays for departing aircraft. Phase IV of the study will review the impact of various capacity enhancement options on the delays and other impacts of the growth of RJ operations.

3.3.2 Baltimore-Washington International Airport

Baltimore-Washington International Airport, now ranked 25th based upon enplanements, is one of the fastest growing airports in the NAS. The FAA forecasts operations at BWI to increase by 36 percent by 2011. Planned improvements potentially include a new runway that, if constructed, will not be operational until 2010 at the earliest. When the new runway is complete, runway 4/22 will be converted to a taxiway. Operations at BWI will be evaluated during Phase III of the Northeast Regional Capacity Design Study. The Design Team has been working with the Volpe National Transportation Center on this effort.

3.3.3 Washington Dulles International Airport

Washington Dulles International Airport is also among the fastest growing airports in the NAS, with operations expected to grow by 37 percent by 2011. Several airport improvements are under consideration. A north-south parallel runway, 1W/19W, would be located west of the existing parallels and north of runway 12/30. Its estimated opening date is 2008. A second parallel runway, 12R/30L, has been proposed for a location southwest of runway 12/30, with expected completion beyond 2010. When completed, these runways may provide triple independent parallel approach capability.

3.3.4 Air Traffic Control Ground Simulations

ASC is participating in an air traffic control ground simulation at Phoenix Sky Harbor International Airport. In addition, because of the FAA's recognized expertise in evaluating capacity enhancements, foreign airport operators have requested assistance. Beginning last year, Ben Gurion International Airport in Tel Aviv, Israel began using the FAA's expertise to improve the operational efficiencies at the airport. Both these studies are utilizing the Technical Center's Airfield Delay Simulation Model (ADSIM) and the Airspace Delay Simulation Model (SIMMOD) to analyze various airfield configurations and to determine daily total aircraft travel times and ground delays.

3.3.5 Phoenix Sky Harbor International Airport

An initiative to assist air traffic controllers with ground operations efficiency was recently conducted at Phoenix Sky Harbor International Airport. The goal was to determine a more efficient use of runways for arrival and departure operations, based on the present runway configuration and several proposed alternate configurations during the construction of a third runway as well as the subsequent reconstruction of the existing runways. This initiative was completed in 2001. The study will be published on the ASC website, and the findings will be summarized in the 2002 ACE Plan.

3.3.6 Ben Gurion International Airport

The Israel Airports Authority asked the Office of System Capacity, to conduct an analysis of the airspace, airfield, and procedural operations at Ben Gurion International Airport, to assist in making recommendations and to analyze those recommendations through simulation modeling. The study was requested because the airport was experiencing annual growth rates of greater than 10 percent. The primary airspace recommendation was to create a more efficient northern arrival route to replace the present route from the west.

Extension of Runway 3/21 to accommodate northern arrivals, new parallel taxiways, high-speed exits, and a new terminal traffic flow were the primary airfield recommendations. Suggested procedural changes included a reduction in the separation standard from five to three miles and simultaneous arrival/departure procedures. The study was released in June 2001.

3.4 Airport Development

This past year there has been increasing focus on new runways as one piece of the aviation congestion solution. While the tragic events of September 11 have reduced system traffic demand by 15%, we must keep in mind that construction of a new runway takes approximately ten years or longer to complete. Efforts by the FAA for streamlining the Federal regulatory process include reducing the time required for project planning and completing environmental reviews. Although new runways are not an option for some airports, new runway construction provides the most significant potential for capacity enhancement.

The following section gives a brief overview of the planning process and timeline for an airport runway project. To give further insight into the complexities and challenges of this process, two very critical phases of the project, the EIS and airport funding are described in further detail. When a project takes longer to complete than planned, there is significant subsequent impact to the costs of the project.

3.4.1 Overview of A New Runway Project

There are several critical activities that occur within each major phase of the runway project development cycle, following is a brief summary of the significant activities occurring within each phase shown in Figure 3-1:

During the Project Planning phase, the airport layout plan is prepared graphically depicting the location of future airport facilities. The Airport Layout Plan (ALP) serves as a record of aeronautical requirements and is used by the FAA in its review of proposals involving the development that may affect the navigable airspace or other missions of the FAA. The appropriate FAA office must have reviewed and approved the location, type, dimension and construction material all proposed for development. Other important areas such as airspace interaction, potential ATC and navaid impacts and obstruction evaluation are reviewed. The development of terminal instrument procedures (TERPs) is initiated at this time. Additionally, capacity/delay analysis economic feasibility and risk analysis may be required.

The Justification and Challenges phase includes land acquisition, the environmental assessment process or environmental impact statement (EIS), Improvement Plan, airport capital plan update, benefit/cost analysis and approval. The EIS aspect is being scrutinized to reduce processing time, and it is discussed in detail later in this chapter.

Litigation/Resolution often results from the outcome of previous project phases, from groups that continue opposing a runway development project. Litigation and resolutions may further delay a project from its initial timeline, as well as the delay itself making many studies obsolete and subsequently requiring that new studies be conducted.

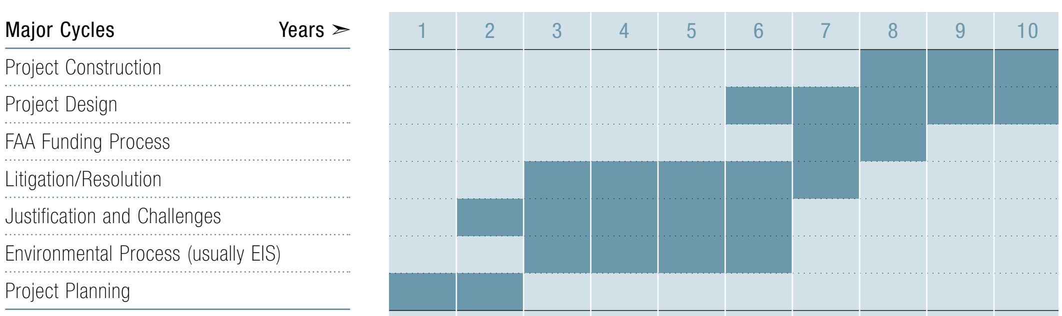
During the FAA Funding Process, major activities include determining the project's financial feasibility, and securing Federal aid, such as AIP and PFCs, a Letter of Intent (LOI) is executed and bond issuances are completed.

Under Project Design, project engineering takes place and the FAA reimbursable Agreement is completed.

Project Construction, or the final project phase, includes land acquisitions and the actual physical building of the runway project, and can be impacted by numerous financial factors. Unanticipated changes in sources of an airport's revenue such as the impact of September 11th, is one example of an event that can delay a project. Also, seasonality has an impact on projects when weather changes a project's original timeline.

There are approximately 40 Federal laws, executive orders and regulations protecting particular parts of the environment, in addition to state laws that are part of the airport project review process. Most major airport changes that require FAA approval also require preparation of an environmental assessment (EA) or an environmental impact statement (EIS). Examples of major airport changes requiring environmental assessment include the proposed construction of a new runway, runway extension, runway strengthening the installation of instrument landing systems, and significant airspace changes. If environmental mitigation measures can be identified that would reduce the environmental impacts below significant thresholds, the FAA can issue a finding of no significant impact (FONSI) and complete the environmental process. If significant environmental impacts are determined from the assessment, the FAA must prepare the EIS. In some instances, due to the extent of the environmental impacts that would result from the proposed airport project, the FAA determines that an EIS is required and proceeds with preparing an EIS rather than starting an EA.

Figure 3-1 Phases of a New Runway Project, from Planning through Completed Construction



3.4.2 Improving the EIS Review Process

AIR-21, which was approved last year, requested that the DOT conduct a study of Federal environmental requirements related to the planning and approval of the airport improvement process. Subsequently, the FAA collaborated with the aviation industry to develop a plan to reduce the time required to build new runways or extend existing runway configurations. An industry sponsored plan for streamlining the EIS review process, called the Expedited Aviation System Enhancement (EASE) Plan, is supported by the American Association of Airport Executives, Airports Council International-North America and the

Airport Consultants Council. The FAA reviewed the EASE Plan, and released six initiatives in May 2001 in its Report to Congress.

3.4.3 FAA Environmental Initiatives

The EIS process cannot be cleanly segregated from the overall planning process. In some cases, new planning data or changes in a project during the process of an EIS cause its timeline to be extended. The DOT seeks to reduce undue delays while maintaining the integrity of the environmental process and complying with all environmental protection requirements.

In May 2001, the FAA identified six initiatives resulting from industry-wide input designed to reduce environmental delays. The guide was released in July 2001.

1 *Establishment of an EIS Team for each new EIS for a major runway project at a large hub primary airport.*
Teams will be strengthened by adding more FAA members, airport proprietors will be asked to contribute more members, and the use of additional consultants will increase resources.

2 *Reallocation of FAA staff resources.*
In FY 2001, five more positions in FAA's Airports Office will convert to environmental positions. A reimbursable funding option allows airports to pay for additional FAA staff.

3 *Maximize consultant resources to perform more EIS tasks.*
This includes providing direct assistance to the FAA project manager, and supporting research and briefing papers.

4 *Streamline the environmental process and product.*
By using more categorical exclusions and shortening and streamlining an EIS or Environmental Assessments/Findings of No Significant Impact (EA/FONSI), time can be saved.

5 *Improve interagency cooperation and coordination.*
This applies to an EIS for airport projects and for the issuance of environmental permits. Heads of other agencies and staff at the regional interagency levels within the FAA will be briefed on the national importance of airport capacity and of the importance of intergovernmental cooperation to avoid unnecessary delays. Greater flexibility and the early involvement of other agencies at the very beginning is another improvement.

6 ***Compile and Issue the FAA Guide to the Best Practices For Environmental Impact Statement Management.***
An Environmental Impact Statement is a Federal responsibility; therefore the primary responsibility for the management of an EIS for airport development rests with the FAA. In addition to the measures initiated by the FAA in collaboration with the aviation industry, legislation is being proposed that would help to reduce the time required to complete an EIS. Proposed laws, such as the Aviation Delay Prevention Act, requires that airports complete a planning and review process for runways in five years.

3.5 Resources For Airport Development

There are generally five resources used to finance airport development, which include airport cash flow, revenue and general obligation bonds, Airport Improvement Program (AIP) grants, Passenger Facility Charges (PFCs), and state and local funding programs. Public grants, PFCs, and airport revenue bonds provide most of the capital funding, while user charges generally cover an airport's operating expenses and the debt service for airport bonds.

Airport revenue is generated from a combination of public and private sources. Private funding for an airport includes the services airlines pay for, such as the rates and charges for landing fees, terminal rents and support facility fees. Also, concession revenues are generated from food and beverage, retail and service businesses located within the terminal, and outdoor car rental and parking facilities. Publicly funded sources are those monies obtained through Federal, state and local grants.

3.5.1 Airport Improvement Program

The Airport Improvement Program (AIP) is administered by the FAA, and plays a critical role in maintaining and expanding our nation's airport infrastructure. The AIP provides federal grants for eligible airport development and planning for capital projects that support airport operations, including runways, taxiways, aprons, and noise abatement. Airport sponsors and non-federal contributors must provide that portion of the total project cost that is not funded with AIP grants. The passage of AIR-21 provided for a substantial increase in AIP funds through the year 2003 to as much as $3.4 billion.

3.5.2 Passenger Facility Charges (PFCs)

With the passage of AIR-21, the maximum passenger facility charge that airports can impose on each boarding passenger was increased from $3.00 to $4.50. The increased funding stream from the higher PFCs will result in critical airport infrastructure being completed sooner. PFCs are a significant source of capital improvement for large, medium, small and non-hub commercial airports. As of 2000, over 300 commercial service airports had PFC approval.

3.5.3 User Charges

Airport user charges include aircraft landing fees; apron, gate-use, or parking fees; fuel-flowage fees; and terminal charges for rent or use of passenger hold rooms, ticket counters, baggage claims, administrative support, hangar space, and cargo buildings. Non-airport user charges include revenue from sources such as terminal concessionaire rentals and fees, automobile parking and interest income.

3.5.4 Bonds: Revenue, General Obligation and Special Facility

The issuance of bonds remains the primary means of financing airport development projects at commercial service airports. Bond debt service for interest, capital, and other costs is a major component of airport user charges. Most airport bond financing has used tax-exempt general airport revenue bonds (GARBs).

Terminal facilities have also been financed with special facility bonds. The introduction of PFCs as an additional source of funds has led to the evolution of a version of the GARB that relies partially or totally on PFC revenues for repayment. Because of the conservative nature of the tax-exempt bond market, these PFC-backed bonds often require special commitments from the FAA to reduce the likelihood of any bond default resulting from some federal actions that could affect future PFC collections.

3.5.5 Other Sources of Funding

State and local governments have contributed to the development and operation of community airports, offering matching grants to secure federal support, providing direct grants to fund airport maintenance projects, and financing the installation of navigation aids. To expand air service and to encourage competition, state and local governments have also supported airport marketing initiatives. Private sources of funding may also be available through airport tenants, third-party developers and other private entities.

3.6 Construction of New Runways, Extensions, Taxiways, and Aprons

Although new runways are not an option for some airports, new runway construction provides the most significant potential for capacity enhancement. A number of the busiest airports have completed new runways or other runway construction projects in the last six years. Figure 3-2 shows that eight new runways were opened from January 1996 to October 2001. Another 21 runway construction projects were completed from January 1996 through October 2001, including 16 runway extensions, one renovation, two reconstructions, and two realignments.

Figure 3-2 Completed Runway Construction Projects January 1996 to October 2001

Airport (ID)	New	Extension	Renovation	Reconstruction	Realignment	Year	Runway
Anchorage International (ANC)		•				1996	32
Port Columbus International (CMH)		•				1996	28R
Dallas/Fort Worth International (DFW)	•					1996	17L/35R
Milwaukee General Mitchell International (MKE)					•	1996	7L/25R
Minneapolis-St. Paul International (MSP)		•				1996	4/22
Omaha Eppley Airfield (OMA)		•				1996	14R/32L
Austin-Bergstrom International (AUS)			•			1997	17R/35L
Boise Air Terminal (BOI)		•				1997	10L/28R
Port Columbus International (CMH)		•				1997	10L
Grand Rapids Kent County International (GRR)		•				1997	18/36
Indianapolis International (IND)	•					1997	5L/23R
Las Vegas McCarran International (LAS)				•		1997	1L/19R
Chicago Midway (MDW)				•		1997	4R/22L
Louisville International (SDF)	•					1997	17R/35R
Grand Rapids Kent County International (GRR)					•	1998	17/35
Little Rock Adams Field (LIT)		•				1998	4L/22R
Memphis International (MEM)	•					1998	18L/36R
Milwaukee General Mitchell International (MKE)		•				1998	7L/25R
Madison/Dane County Regional (MSN)	•					1998	3/21
Palm Springs Regional (PSP)		•				1998	31L/13R
Albuquerque International (ABQ)		•				1999	12/30
Austin-Bergstrom International (AUS)	•					1999	17L/35R
Greenville-Spartanburg (GSP)		•				1999	3L/21R
Philadelphia International (PHL)	•					1999	8/26
Newark International (EWR)		•				2000	4L/22R
Memphis International (MEM)		•				2000	18C/36C
Phoenix Sky Harbor International (PHX)	•					2000	7/25
Palm Beach International (PBI)		•				2000	9L/27R
San Jose International (SJC)		•				2000	12L/30R

The busiest 100 airports also have a large number of runway construction projects in progress or in the planning stage. Figure 3-3 lists runway projects with planned operational dates between November 2001 and December 2006. Thirty-three of the 100 busiest airports have projects in the pipeline, including 26 new runway extensions, and three runway reconstructions. Appendix D shows additional runway construction projects proposed or planned for 2007 and beyond.

Figure 3-3 Runway Construction Projects November 2001 to December 2006.

Airport (ID)	New	Extension	Reconstruction	Runway Identifier	Estimated Cost ($M)	Planned Operational Year	In Progress
Des Moines International (DSM)		•		5/23	$31.0	2001	•
Detroit Metropolitan Wayne County (DTW)	•			4/22	$116.5	2001	•
El Paso International (ELP)		•		4/22	$8.0	2001	•
Kahului (OGG)		•		2/20	$47.0	2001	
Phoenix Sky Harbor International (PHX)		•		8L/26R	$7.0	2001	•
Albany County (ALB)		•		10/28	$5.8	2002	
Birmingham (BHM)		•		5/23	$17.0	2002	
Dayton International (DAY)		•		6R/24L	TBD	2002	
Dallas/Fort Worth International (DFW)		•		18L/36R	$50.0	2002	•
George Bush Intercontinental (IAH)		•		15R/33L	$100.0	2002	
Manchester (MHT)		•		6/24	$120.0	TBD	•
Pensacola Regional (PNS)		•		8/26	$12.3	2002	
Sarasota Bradenton (SRQ)		•		14/32	$5.1	2002	
Cleveland Hopkins International (CLE)	•			5W/23W	$467.0	2003	
Denver International (DEN)	•			16R/34L	$167.0	2003	•
Dallas/Fort Worth International (DFW)		•		18R/36L	$400.0	2003	
George Bush Intercontinental (IAH)	•			8L/26R	$260.0	2003	•
Orlando International (MCO)	•			17L/35R	$203.0	2003	•
Miami International (MIA)	•			8/26	$206.0	2003	•
San Jose International (SJC)		•	•	12R/30L	$61.4	2003	
Charlotte-Douglas International (CLT)	•			18W/36W	$187.0	2004	
Greensboro Piedmont Triad International (GSO)	•			5L/23R	$96.0	2004	
Minneapolis-St. Paul International (MSP)		•		4/22	$11.4	2004	
Minneapolis-St. Paul International (MSP)	•			17/35	$563.0	2004	•
Norfolk International (ORF)	•			5R/23L	$100.0	2004	
Knoxville McGhee-Tyson (TYS)		•		5L/23R	$7.0	2004	
Albany County (ALB)		•		1/19	$7.5	2005	
Hartsfield Atlanta International (ATL)	•			10/28	$1,200.0	2005	•
Boston Logan International (BOS)	•			14/32	$95.0	2005	
Greater Buffalo International (BUF)		•		14/32	$4.9	2005	
Greater Cincinnati-Northern Kentucky Intl (CVG)	•			17/35	$233.0	2005	•
Greater Cincinnati-Northern Kentucky Intl (CVG)		•		9/27	$18.2	2005	
Dallas/Fort Worth International (DFW)		•		17C/35C	$25.0	2005	
Fort Lauderdale-Hollywood International (FLL)		•		9R/27L	$898.0	2005	
Lubbock International (LBB)		•		8/26	$15.0	2005	
Manchester (MHT)		•	•	17/35	$65.0	2005	•

Figure 3-3 continued

Airport (ID)	New	Extension	Reconstruction	Runway Identifier	Estimated Cost ($M)	Planned Operational Year	In Progress
Cleveland Hopkins International (CLE)		•		5R/23L	$40.0	2006	
San Antonio International (SAT)		•		3/21	$20.0	2006	
San Antonio International (SAT)		•	•	12L/30R	$11.0	2006	
Seattle-Tacoma International (SEA)	•			16W/34W	$773.0	2006	
St. Louis-Lambert International (STL)	•			12R/30L	$1,100.0	2006	

3.7 Capacity Enhancements Through New and Converted Airports

Airport development frequently entails the construction of new terminals, new and extended runways, and improved taxiway systems. In large metropolitan areas with frequent flight delays and limited airport expansion possibilities, other options must be explored. New airports, expanded use of existing commercial service airports, and civilian development of former military bases are options available for meeting expanding aviation needs.

While the construction of new airports provides the largest and most significant increase in aviation system capacity, there are several reasons why few new airports have been built in recent decades. These considerations include the high cost of construction, the large acquisition and use of land, the environmental impact of an airport, and whether or not there is sufficient competitive market demand for the proposed air service. Among primary airports, only two new hub airports have been built in three decades: Denver International was completed in 1995 and Dallas/Fort Worth International in 1974. The two primary non-hub airports that have been most recently completed are Northwest Arkansas Regional Airport and Mid-America Airport which both opened in 1998. Mid-America is the St. Louis region's second major airport and serves as a reliever airport for Lambert-St. Louis International Airport and as a joint use facility with Scott Air Force Base.

Currently, several regions are proposing a study or have one underway to determine the feasibility of constructing new regional airports. Another vehicle for capacity enhancement is the Military Airport Program (MAP), which provides grants to current or former military airfields with the potential to improve the capacity of the NAS. These airfields include Base Realignment and Closure (BRAC) participants, and airfields that have entered joint-use agreements to accommodate civil and military users. Many of these airfields are located near congested metropolitan areas and have the potential to provide capacity.

The most significant conversion of a military airfield under the Military Airport Program (MAP) has been the conversion of Bergstrom Air Force Base, Austin, Texas, into a civilian airport, Austin-Bergstrom International, which opened May 1999. Bergstrom is a replacement for Robert Mueller Municipal Airport, and, as is the case with Northwest Arkansas Regional airport, these facilities have shown growth in the number of enplanements significantly above the national average. Another MAP conversion took place at Alexandria Esler Regional Airport, which replaced Esler Field, in Louisiana.

3.8 Capacity Enhancement Through Intermodal Solutions

In addition to the capacity enhancements obtained through airport development, improvements to the U. S. transportation system are being achieved through intermodal solutions. Several DOT initiatives are now underway.

3.8.1 Department of Transportation Initiatives

The Department of Transportation (DOT) has undertaken several funding initiatives contained in the Transportation Equity Act for the 21st Century (TEA-21, P.L. I 05-178) to improve passenger access to the U.S. aviation system. These initiatives involve the FAA but are administered by DOT. Examples of such initiatives include cooperation between the Federal Transit Authority, Federal Railroad Administration (FRA) and the FAA in developing light rail transit systems for JFK International in New York, Lambert Field in St. Louis, and other airports. In addition, the FRA is exploring the option of high-speed trains as alternatives to air, highway, or conventional train transportation in certain congested areas.

3.8.2 FRA High Speed Ground Transportation Initiative

The daunting transportation problems of congestion, air and noise pollution in the air and on highways continue to rise as more citizens rely on the national transportation infrastructure. As a result, exploring alternative means of transportation becomes increasingly important. One such alternative is high-speed ground transportation (HSGT), which includes both high-speed rail and magnetic levitation (Maglev). Maglev trains float on air, eliminating friction. This, coupled with the train's aerodynamics allows unprecedented ground transportation speeds of more than 300 miles per hour (500 kilometers per hour).

Maglev Project Semi-Finalists

Of seven candidates for a $950 million Maglev deployment program, Pennsylvania's Pittsburgh project and Maryland's Baltimore-Washington project were selected as semi-finalists.

Pennsylvania

The 47-mile project links Pittsburgh International Airport with downtown Pittsburgh and the eastern suburbs of Monroeville and Greensburg. The route eventually could extend to Philadelphia. The project has been under study since 1990 and is proposed by the Port Authority of Allegheny County, with the support of state and local agencies, labor unions and community coalitions.

Maryland

The 40-mile project would link Camden Yards in Baltimore (a sport complex and center for recreation and tourism) and the Baltimore-Washington International Airport to Union Station in Washington, DC. This project has been under study since 1994. Proposed by the Maryland Department of Transportation (MDOT), this proposed transportation link between sports venues would support a bid for the 2012 Olympic games.

AIRPORT DEVELOPMENT

The FAA is working on several near-term and long-term strategies to enhance airspace capacity. Significant airspace initiatives include the National Airspace Redesign Plan, the National Choke Points Initiative, the consolidation and expansion of terminal airspace control facilities, and the continuing development of area navigation routes. These initiatives are discussed below.

4.1 The National Airspace Redesign Plan

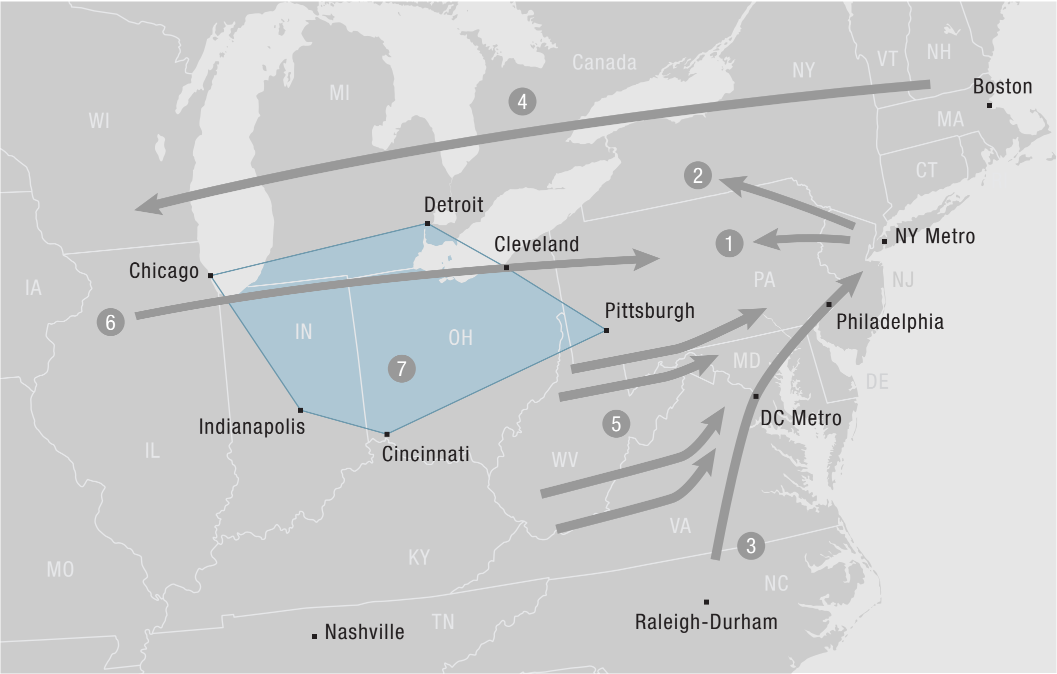
The National Airspace Redesign (NAR) Plan is a multi-year effort to increase the efficiency of the NAS through the re-routing of air traffic, the reconfiguration of the nation's airspace, and more efficient air traffic management. The NAR is pursuing incremental changes to the national airspace structure, consistent with evolving air traffic and avionics technologies. It is initially focused on near-term fixes to airspace choke points that significantly contribute to flight delays.

4.1.1 The National Choke Points Initiative

The National Choke Points Initiative focuses on short-term actions to improve air traffic flow at seven problem areas in the area east of the Mississippi, as far north as Boston and as far south as Atlanta. This area includes many of the country's major population areas and most congested airports.

Figure 4-1, which identifies the seven national choke points, shows that the choke points are not actually discrete sites, but rather airways or sections of airspace. The figure also shows the extent to which the choke points overlap; congestion at one choke point can easily create or exacerbate congestion at another.

Figure 4-1 National Choke Points Map



Twenty-one action items have been identified as solutions to the seven choke points. Sixteen of the action items have been completed, and the remaining items will be completed by July 2002. The seven choke points, the problems faced at each choke point, and the steps that have been or will be taken to correct those problems are described below.

Choke Point 1: Westgate Departures

In the New York Terminal Radar Approach Control facility (TRACON) the high volume of turboprop and air carrier jets that depart from the New York area airports to the west are required to navigate through the Westgate departure fixes. Traffic complexity escalates as a result of separating and sequencing the slower turboprop flights and the faster jet traffic, resulting in departure delays. Further complicating matters, Washington Dulles and Baltimore/Washington airport arrivals descend through New York departures.

As a solution to the problems at this choke point, the FAA has begun rerouting propeller aircraft departing from the New York and New Jersey metropolitan airports and aircraft bound for Dulles and Baltimore/Washington that transit New York en route center airspace. This adjustment has reduced congestion and the number of ground delays. In addition, a coordinator position for the New York TRACON has been proposed to improve coordination between the New York TRACON and the area airports. When the new position is implemented, arrival flows will be expedited and the length of departure stops will be reduced.

Choke Point 2: Northgate Departures

This choke point is located in New York en route center airspace. Flights that depart north from the New York area airports are required to navigate through the Northgate departure fixes. Traffic management initiatives such as holding, departure stops, and miles-in-trail restrictions on departures are often required to alleviate congestion.

Traffic management restrictions are now being reviewed throughout the day to determine the most appropriate restrictions, with the objective of creating more efficient traffic flows. In addition improvements in automation have increased the amount of information about congested routes that is displayed to TRACON controllers, allowing them to be more selective in imposing flow restrictions and departure stops. Also, restricting Pittsburgh arrivals to flight level 280 has allowed New York departures to climb higher than the Pittsburgh arrivals, reducing complexity in this sector. As a result of these actions, departure stops at New York metropolitan airports were reduced 37 percent as measured in August of 2000. This is now a standard operating procedure.

Choke Point 3: Washington Center Sectors

Currently, the arrival flows into Newark and LaGuardia pass through narrow sectors located in the airspace of the Washington en route center. These sectors can only accommodate a few aircraft in a holding pattern.

Swapping arrival flows for Newark and LaGuardia will increase the flow rate for traffic to New York airports from the Washington en route center by balancing the traffic load. This change will reduce the need for holding of New York arrival traffic.

Choke Point 4: Westbound Jet Route from Boston Center

Jet route 547 (J547) is the major westbound airway from the Boston en route center. Miles-in-trail restrictions are normally imposed on traffic using this route to Chicago O'Hare, Chicago Midway, Detroit, and Cincinnati. The lack of alternate jet routes and use of air traffic restrictions results in ground and airborne delays.

Westbound flights from the New England region are being re-routed through Canadian airspace, reducing congestion in en route airspace and providing greater access to route J547 for New York departures. In addition, Detroit departures to seven locations, including Boston, Providence, and Kennedy airports have begun to traverse Canadian airspace when domestic routes are impacted by weather.

Choke Point 5: Great Lakes Corridor

The Great Lakes Corridor is the area south of the Great Lakes extending from Chicago to Pittsburgh to Cincinnati to Indianapolis. It includes airspace in Chicago, Cleveland, and Indianapolis Centers. These three en route centers have the responsibility for moving arrival and departure flows into and out of the New York Center and within the Great Lakes en route centers. The airspace in these en route centers is very complex and congested. When Cleveland Center provides spacing for flights to airports in the northeast, traffic backs up into Minneapolis Center, affecting departures from Chicago O'Hare to the south and east. Indianapolis Center sequences, spaces, and holds traffic bound for St Louis, Chicago O'Hare, Cincinnati, and Detroit. Cleveland Center imposes miles-in-trail restrictions for westbound traffic, and also provides spacing for the Washington airports and holds for Philadelphia. Traffic must flow around the Buckeye Military Operations Area, just northeast of Cincinnati, when the military is using that airspace.

One approach to this choke point has been to restrict aircraft flying between certain city-pair airports to lower altitudes. In addition, the national route program (NRP) routings east of the Mississippi have been tactically modified to provide more predictable departure times and reduce airspace congestion. Further, seven new sectors have been opened in this area to help manage the tremendous congestion. Also, the FAA Command Center reviews arrivals to Newark, New York Kennedy, and Philadelphia every day during its daily strategic planning teleconference to determine which traffic management initiatives should be implemented. Routes are then developed to provide more efficient flows.

Choke Point 6: High Altitude Holding of East Coast Arrivals

High altitude en route holding of traffic in the Cleveland, Indianapolis, Chicago, and New York en route centers bound for east coast airports is common. Sector capacity is reduced due to the large amount of airspace required for holding patterns at high altitudes, resulting in flight delays. This affects traffic at Chicago O'Hare, Detroit, Cleveland, Pittsburgh, and Cincinnati, incurring delays and unplanned departure stops.

Planned spacing of aircraft earlier in the flight and tactical modification of NRP routes reduces congestion and complexity in high altitudes and minimizes high altitude holding.

Choke Point 7: Departure Access to Overhead Streams
Saturated airways delay flights departing eastbound from Chicago O'Hare, east and southbound from Detroit, and north and eastbound from Cincinnati.

By adding new sectors, re-routing flights through Canadian airspace and restricting certain flights to lower altitudes between specific city-pairs, flights from Chicago, Detroit and Cincinnati to eight destinations requiring access to the overhead stream experienced 7.5 percent fewer delays in May 2001 as compared to May 2000.

4.2 High Altitude Redesign

Aircraft that are flying near or across sector boundaries are frequently delayed as they are handed off from one facility to another. The objective of high altitude airspace redesign is to allow users to fly preferred routes and altitudes with fewer restrictions and delays than the present system requires. The airspace above FL350 will be redesigned to allow this flexibility with minimal constraints due to sector boundary stratification by establishing a few very large high altitude sectors.

Current procedures to separate traffic require longitudinal separation of five miles in en route airspace. When two aircraft are flying along the same airway, they are kept in trail, one behind the other, which can delay the trailing plane. If the two aircraft are heading for different airports, it should be possible for them to fly on parallel routes, maintaining safe separation, but enabling both to operate at optimal speed. High altitude redesign will incorporate parallel routing where possible. Parallel routing will reduce the inefficiencies and workload created by placing aircraft in trail as the primary means of providing structure and controlling volume. A challenge for the FAA will be achieving the correct balance between structure (predefined routes) and flexibility (user preferred routes).

High altitude redesign will initially address changes that are supportable with currently available technology and resources. The airspace will be designed to provide the maximum utilization of advanced area navigation (RNAV) routing given these constraints. RNAV routes will be designed to most efficiently accommodate the transition to congested terminal areas. To achieve desired flexibility; the airspace will be designed to facilitate reduced vertical separation minima (RVSM), which will allow more aircraft to efficiently use the available airspace. Preliminary high-altitude airspace modifications will be tested in the northwest portion of the country in early 2003.

4.3 New York/New Jersey/Philadelphia Metropolitan Redesign Project

More passengers fly in and out of the New York/Philadelphia metropolitan area than any other area in the U.S. In one year, Kennedy, LaGuardia, Newark, and Philadelphia airports handle more than 99 million passengers.

These airports and their terminal area airspace were not designed to handle this volume of traffic, and as a result are among the ten most delayed airports in the U.S. No new runways are currently planned any of these airports, so modifying the airspace redesign is required to improve efficiency.

The FAA has devised at least four alternative concepts to relieve airspace congestion generated by Newark, Kennedy, LaGuardia, Philadelphia and several regional and general aviation airports in the New York metropolitan area. The alternatives address traffic in the airspace currently controlled by the New York TRACON, roughly a 50-mile radius around the TRACON.

Under one concept, all departing aircraft would be routed eastbound over the Atlantic, regardless of their destination. Aircraft would turn back toward their destination after gaining altitude to reduce the impact of aircraft noise on the underlying communities. This alternative is supported by individuals in the communities currently subject to aircraft noise, but would increase flight costs.

Another concept would establish four arrival areas around the metropolitan area. Departing aircraft would be routed between the four arrival areas. A third concept would achieve efficiencies by making minor adjustments to existing traffic flows, and a fourth would combine the best features of the other alternatives. The FAA is holding a series of public meetings to further develop the concepts and to try to reach a consensus.

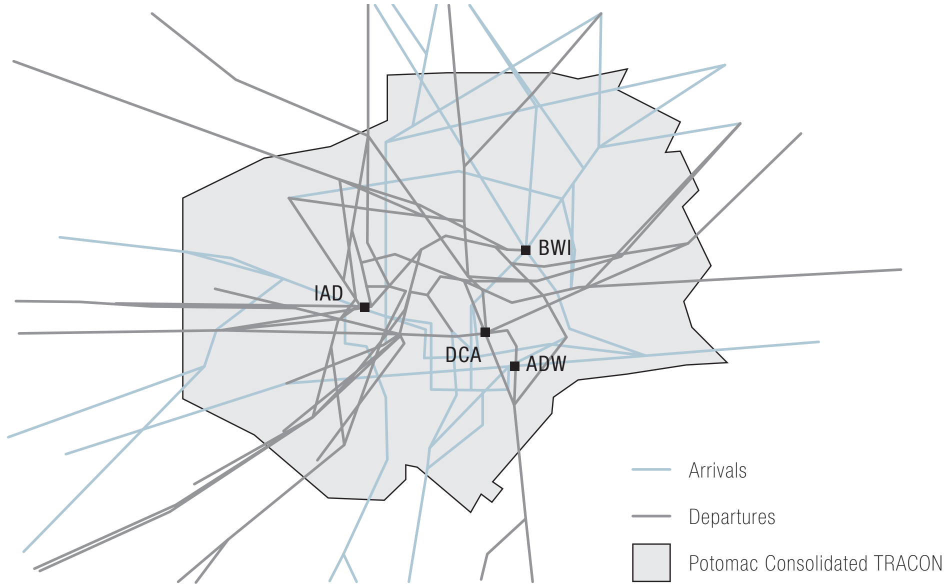
4.4 Consolidation of Terminal Airspace Control

Typically, a TRACON controls aircraft approaching and departing between 5 and 50 miles of an associated airport. In metropolitan areas with several airports, the terminal airspace of adjacent airports may overlap, creating a complicated airspace structure. In these circumstances, consolidating two or more TRACONs into a single facility can simplify that airspace structure. The consolidation improves communications among controllers handling operations over a wide geographic range and increases their flexibility in merging, maneuvering, and sequencing aircraft to and from the area airports. Additional flexibility can be gained by bringing portions of en route airspace under TRACON control, especially where comprehensive radar coverage allows three-mile spacing rather than the five-mile spacing that is customary in the en route environment. Two examples of significant FAA efforts to consolidate airspace control are the Potomac Consolidated TRACON (PCT), and the New York Integrated Control Complex (NYICC). The PCT primarily involves consolidation of TRACON airspace with the addition of relatively small areas of en route airspace. The NYICC would bring large amounts of en route airspace under TRACON control.

4.4.1 Potomac Consolidated TRACON

The Washington/Baltimore Metropolitan Area is served by four major airports-Ronald Reagan Washington National (DCA), Dulles International (IAD), Baltimore-Washington International (BWI), and Andrews Air Force Base (ADW). These four airports are located within a geographic area that in many places would be served by a single airport. The existing airspace configuration of the four TRACONs is shown in Figure 4-2.

Figure 4-2 Terminal Airspace in the Washington/Baltimore Area



In the Washington/Baltimore area, the responsibility for handing off departures from terminal airspace to an en route center is assigned to specific TRACONs based on the direction of each flight. For example, DCA coordinates the hand-off of southbound departures from each airport's airspace to the Washington Center. The Dulles TRACON is responsible for most west and northwest bound jet traffic, and the Baltimore TRACON is responsible for propeller traffic to the east and northeast.

Departures require significant vectoring to sequence them for hand-off to the appropriate en route center, which requires coordination among the TRACONs. For example, aircraft that depart southwest from BWI must be coordinated with controllers from BWI and DCA prior to being handed off to the Washington en route center. This one procedure requires the involvement of three controllers. Similarly, arrivals also require coordination among the TRACONs. The New York and Washington en route centers manage arrivals to the Washington airports as a series of single streams, separating them by destination only as each flight descends into TRACON airspace. But because of the complexity of the terminal airspace, more than one TRACON is usually involved. For example, some DCA arrivals from the West are routed through the IAD TRACON before being passed to the DCA TRACON.

The Potomac Consolidated TRACON will combine the four Baltimore/ Washington area TRACONs and the Richmond TRACON into a single new facility. The FAA expects to commission the new facility in May 2002.

The consolidated TRACON will have continuous radar coverage from south of Richmond, Virginia to north of Philadelphia, Pennsylvania, and from as far west as Cumberland, Maryland and east to Cambridge, Maryland. The PCT will gain control of several pieces of airspace that are currently controlled by the en route centers. The expanded and consolidated terminal area airspace will allow the PCT to handle inbound and departing aircraft more efficiently. Proposed airspace changes are the subject of an ongoing environmental impact study (EIS) analyzing traffic patterns and alternatives with the goal of increasing air traffic system efficiencies, enhancing the safety of flight, and reducing aircraft noise exposure to the public. One alternative for more efficient routing of traffic is a ring of fixes around the Baltimore/Washington area to allow direct routing to and from major cities (Figure 4-3). Another alternative is similar to a "four-corner post" structure, which would establish four arrival and departure areas around the Baltimore/Washington area (Figure 4-4). The FAA plans to name its preferred alternative in the fall of 2002, and to implement the new airspace design by March 2003 (approximately one year after the PCT is commissioned).

Figure 4-3 PCT Jet Traffic Routing Alternative: Ring of Fixes

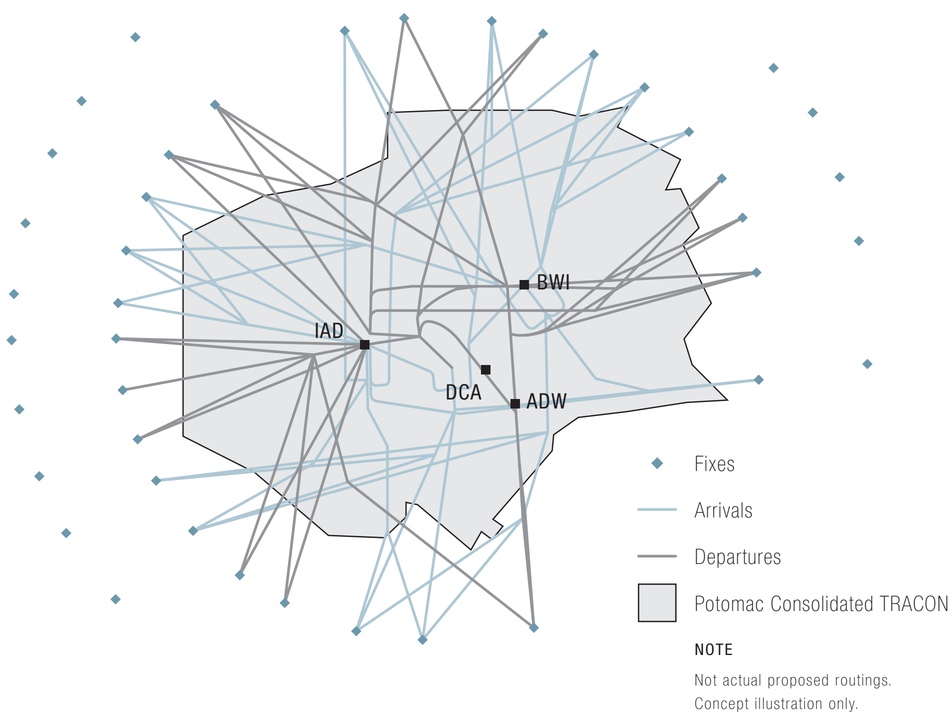
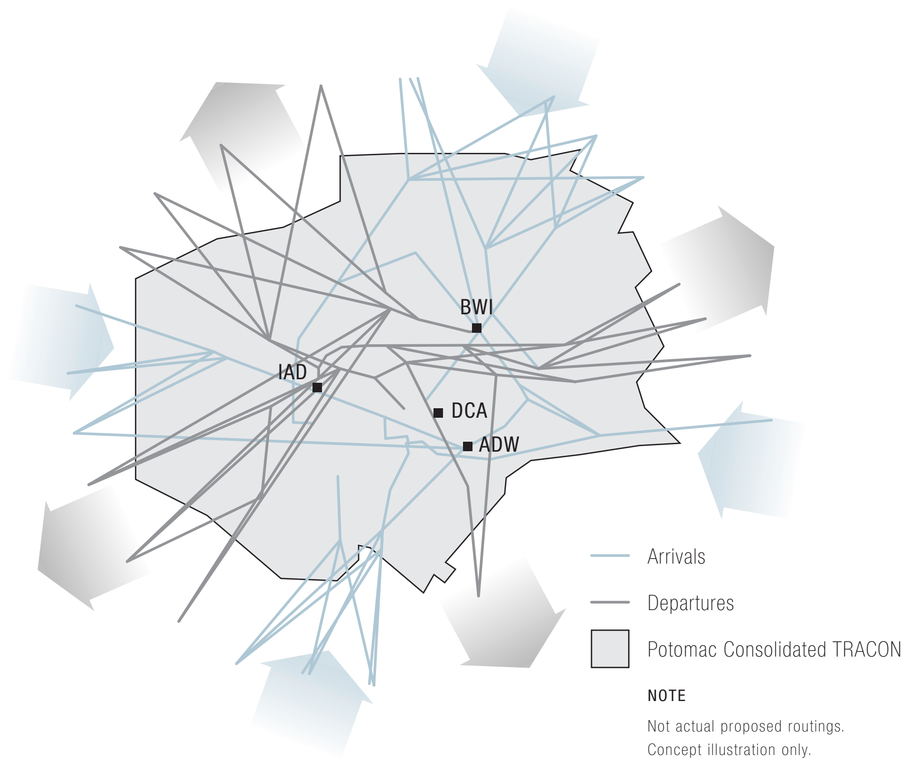


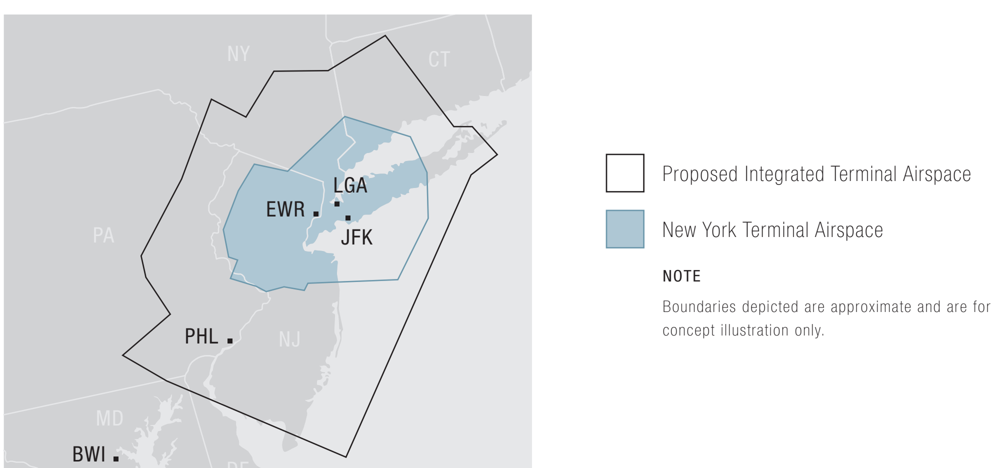
Figure 4-4 PCT Jet Traffic Routing Alternative: Four Cornerpost



4.4.2 New York Integrated Control Complex (NYICC)

The FAA is in the planning stages of the redesign of the airspace in the New York metropolitan area. This concept, the New York Integrated Control Complex (NYICC) involves the "terminalization" of portions of the en route airspace currently controlled by the en route facilities abutting the New York TRACON (Figure 4-5). Bringing portions of en route airspace under TRACON control will allow for reduced separation and better coordination, resulting in greater efficiency in airspace management around New York.

Figure 4-5 Single Facility for En Route and Terminal Operations in New York



Specifically, NYICC would combine terminal airspace from the New York TRACON with airspace from the en route centers in New York, Boston and Washington, as well as that of adjacent TRACONs. Presently, fragmentation of arrival and departure corridors across multiple en route centers causes inefficient use of existing airspace. Arrival and departure management decisions spread among multiple facilities limits responsiveness and the flexibility needed to address the dynamic nature of the northeast corridor traffic flows.

The area encompassed by NYICC will provide additional airspace to support load balancing and holding patterns within the TRACON, adding efficiency to arrival and departure operations of the busy New York, New Jersey, and Philadelphia airports. NYICC will enhance benefits expected from the airspace design changes proposed in the NY/NJ/PHL Metropolitan Redesign Project. The resulting terminal benefits will include reduced delays, reduced restrictions, increased flexibility, and enhance operations during severe weather events.

4.5 Area Navigation Routing

One of the limiting factors of the NAS is that aircraft must generally follow airways that are based on a system of ground-based navigational aids. Following those airways involves flying from one navigational fix to another, connecting a series of doglegs, which increases the distance flown and the time required to do so. Over the past four years the FAA has been developing advanced area navigation routes, which are typically more direct than routes determined by ground-based navigational aids. Advanced RNAV routes can be safely flown by aircraft equipped with present day flight management systems (FMS) or GPS. Several recent advanced RNAV route development initiatives are described briefly below.

- In the Eastern Region, 104 RNAV city-pair routes were developed collaboratively between local air traffic facilities and Atlantic Coast Airlines. The routes are flown daily by the airline, resulting in an estimated savings of $4.1 million annually, exceeding the cost of equipping the airline fleet with GPS.
- In the Western-Pacific and Northwest Mountain Regions, 21 RNAV off-airway direct routes between key cities in the Pacific Northwest (Seattle, Portland, Vancouver) and the Western-Pacific Region (Los Angeles, San Francisco, San Jose, Oakland, Ontario, Palm Springs, John Wayne-Orange County, Las Vegas, and Phoenix) were developed in conjunction with Alaska Airlines and the Western-Pacific and Northwest Mountain regional air traffic facilities in coordination with the Air Transport Association. The objective of these routes is to provide seamless RNAV departure, en route, and arrival between the selected airports for all appropriately equipped aircraft. Annual savings to Alaska Airlines are projected to approach $800,000.
- In the Southern Region, the FAA designed and implemented 36 routes for use by aircraft equipped with advanced navigation systems, primarily between Atlanta, Daytona Beach, Jacksonville, Orlando, Tampa, West Palm Beach, Ft. Lauderdale, and Miami. Delta Airlines is the principal air carrier utilizing the routes,

operating 117 flights daily. Delta projects a yearly savings of $2.6 million. Additional RNAV routes are being developed from Charlotte to the seven Florida airports with US Airways as the principal user. The development of RNAV departure and arrival routes at Atlanta Hartsfield, Miami, and Ft. Lauderdale airports will provide RNAV benefits from runway to runway. The remaining central Florida airports will be included as airspace redesign is completed on the Suncoast TRACON project.

- In 1999, Atlantic Southeast Airlines (ASA) requested city-pair RNAV routes to complement the acquisition of 50 new regional jets over a four-year period. The FAA Southern region in coordination with associated regions and air traffic facilities established 56 routes to facilitate traffic flow in terminal airspace, resulting in projected annual savings of $2 million for ASA.
- Until recently, general aviation aircraft flying between the Northeastern U.S. and Florida had to bypass restricted airspace surrounding the Charlotte N.C. airport, increasing their flight distance by as much as 50 miles. FAA personnel at the Charlotte air traffic control tower identified 12 routes through the Class B restricted airspace that would keep RNAV-capable aircraft that fly at low altitudes clear of the major air carrier's primary traffic corridors. Aircraft that file these routes are assigned altitudes from 4,000 to 6,000 feet. Pilots who do not have the appropriate GPS equipment may request vectors along the new routes. The new routes went into effect in January 2001.
- In September 2001 three new advanced RNAV routes were implemented in the northeastern Gulf of Mexico. Even in the short time they have been in existence, these routes have provided a tremendous benefit to both the controllers who manage the airspace and the system users. The airlines have estimated that the cost savings they will realize from the use of these new routes will exceed $21 million per year. Delays due to capacity constraints have been greatly reduced, and the flexibility afforded by having three routes instead of one has proven to be a highly effective tool for air traffic controllers.

4.6 RNAV Terminal Routes

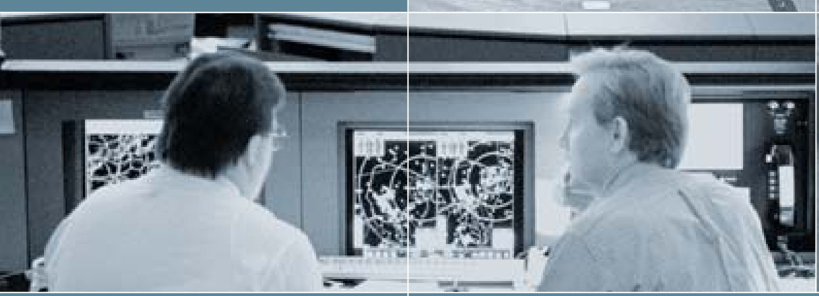
Airspace congestion in the vicinity of airports and en route often causes arrival and departure delays. At many airports, flights must funnel through common arrival or departure fixes, which due to traffic volume and the variety of aircraft types with different performance characteristics flying the in the same airspace, reduces throughput rates. Optimizing traffic flow in the terminal area to allow users to efficiently transition in and out of terminal airspace while making maximum use of airspace and airport capacity is an important component of the national airspace redesign. The development of RNAV arrival and departure procedures will allow for more efficient use of constrained terminal airspace.

RNAV allows for the creation of arrival and departure routes that are independent of existing fixes and navigation aids, and provides multiple entries to existing Standard Terminal Arrival Routes (STARs) and multiple exits from Departure Procedures (DPs).

Airports with multiple runways or with shared or congested departure fixes benefit the most from segregating departures and providing additional routings.

FAA regions have identified RNAV terminal procedure needs for the next four years. The FAA, with the support of MITRE/CAASD has developed a standardized process and tool for designing, modeling, and simulating aircraft navigation using RNAV terminal routes called Terminal Area Route Generation, Evaluation, and Traffic Simulation (TARGETS). TARGETS will be used to support the development of new RNAV terminal routes.

5
OPERATIONAL PROCEDURES



In the interest of ensuring safety and increasing the utilization of capacity, the FAA continually modifies the procedures governing the operation of aircraft in the NAS. Modifications to existing operational procedures allow controllers to provide more flexibility to pilots in determining their routes, altitude, speed, and departure and landing times with little or no additional investment in airport infrastructure or air traffic control equipment. The FAA develops new operational procedures to implement changes in airspace design, to take advantage of improved aircraft and avionics performance, to maximize the utilization of a new runway, or simply to make the existing air traffic management system work more efficiently. These procedures are discussed in Chapter 5.

Several offices in the FAA are involved in developing and implementing new procedures. The FAA Aviation System Standards Office is responsible for developing and flight inspecting procedures for instrument approaches and departures at individual airports. These instrument flight procedures enable aircraft to continue operations during adverse weather. The Air Traffic Planning and Procedures Program develops standards for effectively implementing new air traffic procedures in the NAS. It recently began deploying a tool to assist air traffic facilities in the development of new arrival and departure procedures. At the national level, the FAA's Air Traffic System Command Center (commonly referred to as the Command Center) is responsible for coordinating air traffic by addressing localized problems through system-wide solutions. In the Spring/Summer initiatives for 2000 and 2001, the Command Center modified the processes that it employs to help minimize the traffic bottlenecks that occur when storms disrupt flights.

Although less expensive and time-consuming than implementing other capacity-enhancing solutions such as building new runways, the development and implementation of new procedures can be a complex process. The collaboration of the air traffic controllers and pilots who will be using the procedures is essential. In addition, both controllers and pilots must receive appropriate training before the procedures can be implemented.

5.1 Spring/Summer 2001

The Spring/Summer 2001 (SS2K+1) Plan is a continuation and enhancement of Spring/Summer 2000, a joint FAA/industry project begun in the spring of 2000 to maintain system predictability and capacity in times of severe weather, particularly during the summer when convective weather can cause flight disruptions nationwide. Key elements of the SS2K+1 Plan are described below.

5.1.1 Strategic Planning

The strategic planning team at the Command Center conducts conference calls with airline and air traffic control representatives every two hours, from 3 am to 11 pm, 7 days a week. During the call, the participants generate two- and six-hour system plans, taking into consideration potential problems caused by adverse weather or high traffic volume. The resulting strategic plan is posted on the Command Center web site. This function was also part of Spring/Summer 2000, but the number of conference calls has been expanded to cover a larger portion of the day.

5.1.2 Route Coordination

The FAA and the airlines have worked together to develop routing alternatives to facilitate efficient re-routing of traffic during severe weather. The availability of pre-determined alternate routes provides flexibility in dealing with most severe weather events and expedites the route coordination process. It also allows airlines to plan ahead for possible route changes when severe weather is forecast. The number of alternative routings has been increased since the summer of 2000. For example, the severe weather routes database now contains 215 possible routes from Boston Logan to 96 destination airports, compared to 114 routes to 38 cities available in 2000.

5.1.3 Collaborative Convective Forecast Product

The Collaborative Convective Forecast Product (CCFP) is a system for developing and distributing a single convective forecast four times a day. The primary goal of the CCFP is to improve coordination and decision-making for traffic management. The CCFP is designed to provide two- to six-hour forecasts of convective activity. It is not intended for use in tactical planning (zero to one hour). Forecasts are based on input from the National Weather Service's Aviation Weather Center (AWC), the FAA's Center Weather Service Units (CWSU), and airline meteorologists. Collaborative forecasts for the New York, Washington, Chicago, and Dallas areas are given top priority.

Training has been a key element of SS2K+1. Conceived during the Spring/Summer 2000 post-season review, the training's purpose was to explain the direction and goals of the SS2K+1 to all air traffic personnel. Airlines and support groups also received training to support the collaboration process. The FAA trained more than 15,000 air traffic controllers, traffic management specialists, air traffic managers, and airline ATC representatives on the technological improvements and system goals and expectations.

Keeping the flying public informed is another important aspect of SS2K+1. The public is now able to receive up-to-date information on the status of airport delays via the CNN airport news service as well as on the Command Center web site.

5.2 Reduced Separation Standards

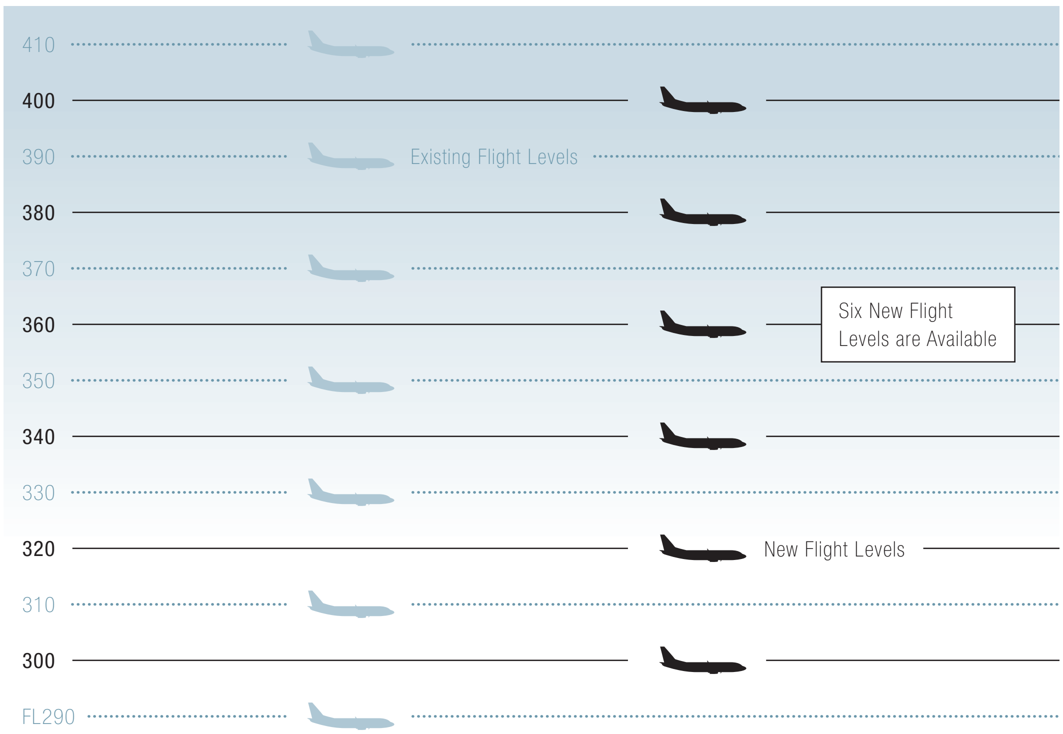
Reduced separation standards are being implemented incrementally in various regions to take advantage of technological advances that improve the accuracy and timeliness of position information available to pilots and air traffic controllers. Vertical and horizontal separation minima have been already been reduced in large portions of oceanic airspace. Reduction of vertical separation standards for U.S. domestic airspace is in the planning stages.

5.2.1 Reduced Oceanic Vertical Separation Minima

Procedures implemented more than 40 years ago required a 1,000-foot minimum vertical separation between IFR aircraft below FL290 and a 2,000-foot separation above FL290. The 2,000-foot separation above FL290 was necessary because the instruments used to measure aircraft altitude at that time had relatively poor accuracy at higher altitudes.

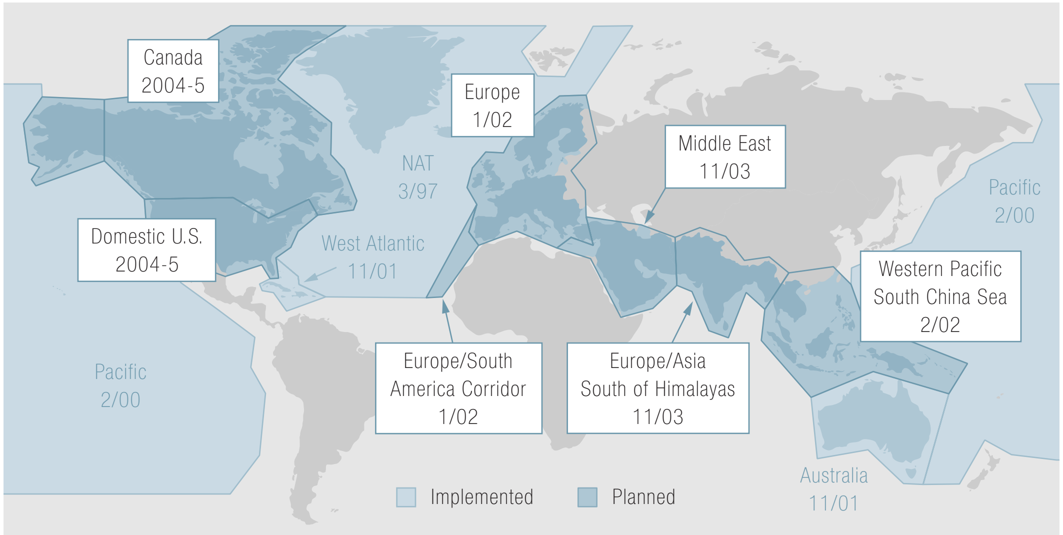
Over the past few years, the U.S. and other nations providing oceanic control, in cooperation with the International Civil Aviation Organization (ICAO) and international air carriers, have been reducing vertical separation minima from 2,000 feet to 1,000 feet in selected oceanic airspace. The goal of this initiative, called Reduced Vertical Separation Minima is to increase airspace capacity and to allow more aircraft to operate at fuel-efficient altitudes (Figure 5-1). To ensure that aircraft will be able to maintain separation, aircraft that want to participate in RVSM must meet stringent altimetry system standards. The height-keeping performance of participating aircraft is monitored under two main airways, using aircraft radar returns. Aircraft that do not pass through those monitoring areas are evaluated using portable measuring devices. Aircraft that are approved for RVSM are eligible to conduct RVSM operations worldwide. Approximately 23 percent of aircraft that operate in the U.S. above FL290 (2,500 of 11,100) are currently RVSM-approved.

Figure 5-1 Reduced Vertical Separation Minima to 1,000 Feet



RVSM is being phased in by altitude and airspace region. It was pioneered in the North Atlantic airspace. Aircraft crossing the North Atlantic fly along a highly organized route structure. Traffic flows primarily westbound from Europe in the morning and east-bound from North America in the evening. RVSM was implemented in the North Atlantic airspace from FL330 to FL370 in 1997 and was expanded to FL310 to FL390 in 1998. RVSM in the North Atlantic has successfully increased flight efficiency and resulted in user-estimated fuel savings of $32 million annually. Full implementation of RVSM for FL290 to FL410 in the North Atlantic is planned for January 2002.

Figure 5-2 RVSM Implemented and Planned



The Western Atlantic route system is a complex web of fixed routes that frequently experience high traffic volume. The heaviest traffic flow is North-South from the United States to Puerto Rico. RVSM in the Western Atlantic for FL310 to FL390 will be phased-in starting in January 2002, and expanded to include FL290 to FL410 later that year.

RVSM was implemented in the Northern Pacific from FL290 to FL410 in 2000. Projected fuel savings for U.S. carriers as a result of RVSM in the Pacific are expected to exceed $150 million annually. Figure 5-2 shows worldwide progress and plans for RVSM implementation.

5.2.2 Reduced Oceanic Horizontal Separation Minima

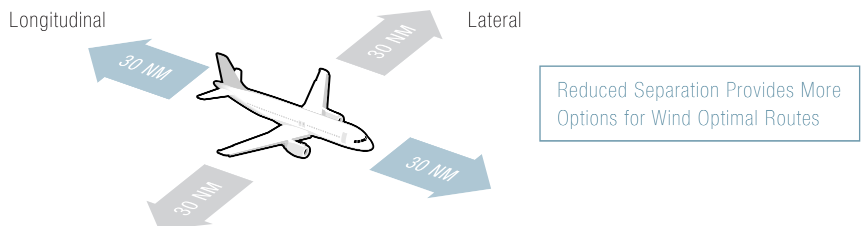
The current oceanic air traffic control system uses filed flight plans and position reports to track an aircraft's progress and ensure that separation is maintained. Position reports, sent by pilots over high frequency radio through a private radio service that relays the messages to the air traffic control system, are infrequent (approximately one per hour). Radio communication is subject to interference, disruption, and delay because radio operators are required to relay messages between pilots and controllers. These deficiencies in communications and surveillance have necessitated larger horizontal separation minima when flying over the ocean out of radar range.

As a result of improved navigational capabilities made possible by technologies such as the global positioning system (GPS) and controller pilot data link communications, both lateral and longitudinal oceanic horizontal separation standards are being reduced.

Oceanic lateral separation standards were reduced from 100 to 50 nautical miles in the Northern and Central Pacific regions in 1998 and in the Central East Pacific in 2000. The FAA plans to extend the 50 nautical mile separation standard to the South Pacific. Because flights along the South Pacific routes are frequently in excess of 15 hours, the fuel and time savings resulting from more aircraft flying closer to the ideal wind route in this region are expected to be substantial.

There are plans to reduce oceanic lateral and longitudinal separation minima to 30 nautical miles in portions of the South Pacific airspace by 2006 (Figure 5-3). These reduced separation minima will only apply to aircraft with sufficiently accurate navigation equipment (RNP-4),[5] controller to pilot data link communication, and enhanced surveillance capabilities provided by automatic dependent surveillance.

Figure 5-3 Reduced Oceanic Separation



5.3 U.S. Domestic Reduced Vertical Separation Minima

Planning began in 2000 on the phased implementation of reduced vertical separation in high altitude U.S. domestic airspace. In the first phase, domestic RVSM (DRVSM) will be implemented between FL350 and FL390, with a progressive extension to full DRVSM (FL290 to FL410).

As with RSVM in oceanic airspace, aircraft that operate in DRVSM airspace must demonstrate that they have certain communication and navigation capabilities and meet certain calibration standards. This will require new equipment such as altimeters and transponders and certification for nearly all aircraft that fly in RVSM airspace. Phased implementation will allow flexibility for operators of aircraft that will be costly to modify (particularly for GA users) or are not RVSM-approved at the beginning of the phase-in.

Prior to full phase-in, non-equipped aircraft will be able to operate below FL 350 or to pass through RVSM flight levels to operate normally above FL390. DRVSM will make six additional flight levels (for a total of 13) available and is expected to result in fuel savings of one percent. It will give controllers more flexibility in dealing with weather re-routes and will reduce delays associated with congested airspace above FL290. The FAA expects to begin the phase-in of DRVSM in December 2004.

Although a phased implementation is planned, the FAA is examining the possibility of implementing DRVSM from FL290 to FL390 at one time, with no phase-in, beginning in late 2004. This approach mirrors RVSM plans in Europe, where DRVSM is scheduled to be implemented in January 2002.

5.4 Increasing Civilian Access to Special Use Airspace

The FAA routinely works with the Department of Defense (DoD) to provide civilian access to special use airspace (SUA) when it is not being used by the military, through agreements concerning civilian access to specific SUA and the development of automated information systems that report on the availability of SUA. Civilian aircraft are normally sent over, under,

5 RNP-4 approved aircraft are equipped with navigation systems that can navigate within 4 miles of desired position with 95% probability.

or around special use airspace. By gaining access to SUA status information, pilots can sometimes avoid these deviations, saving both fuel and time.

As the volume of civil air traffic continues to increase, the pressure for close coordination between the FAA and the military intensifies. In recent years, the volume of airspace needed for testing of and training in military weapon systems has increased, although in many cases the amount of time that the military requires has been shorter.

In cooperation with DoD, the FAA has developed a computer information system, the Special Use Airspace Management System (SAMS) to provide pilots, airlines, and controllers with the latest status information, current and scheduled, on special use airspace. DoD operates the Military Airspace Management System (MAMS), which gathers information about SUA scheduling and transmits this data to SAMS. These two systems, working in concert, ensure that the FAA and system users have access to daily information on SUA availability on the internet. A prototype system called Special Use Airspace/In-Flight Service Enhancement would be used to disseminate graphic depictions of near-real time SUA information to airlines and GA users.

The Central Altitude Reservation Function (CARF) is another FAA component supporting military operations. SAMS handles schedule information regarding “fixed” or “charted” SUA while CARF handles ad hoc time and altitude reservations. Both subsystems deal with planning and tracking the military’s use of the NAS.

In July 2000 the FAA and the U.S. Navy began coordination to allow civilian use of offshore warning area airspace from Northern Florida to Maine to circumvent severe weather. To facilitate the use of this airspace, the FAA established waypoints in East Coast-offshore airspace along four routes for conducting point-to-point navigation when the DoD has released that airspace to the FAA. The waypoints take advantage of RNAV capabilities and provide better demarcation of airspace boundaries, resulting in more flexible release of airspace in response to changing weather. The offshore routes were tested and refined in November 2000 to ensure that no procedural problems existed before the 2001 Spring/Summer storm season.

In Texas, an operational trial to increase civilian access to the Brownwood and Westover military operations areas (MOAs) is in the planning stages. In this project, regional airline and GA participants will have the option of viewing the published, daily, and near-real time schedules of Brownwood and Westover MOAs via the internet. Based on this information, airspace users can make better-informed pre-flight decisions regarding flight planning and fuel loading, and in-flight decisions regarding routing in the vicinity of these two MOAs.

Operational trials to increase civilian access to SUA are also being conducted at Edwards Air Force Base in California, the Buckeye Military Operations Area in Ohio, and the Palatka Complex in Florida. The purpose of all these trials is to implement more efficient, timely, accessible information systems to give civilian users more access to military airspace when it is not in use.

5.5 Area Navigation (RNAV) Approaches

The FAA is developing RNAV instrument approaches that do not require the use of ground-based navigational aids to capitalize on GPS capabilities. The RNAV approach procedures are being published in new instrument approach charts intended for all aircraft. The new approach charts include lateral navigation (LNAV) and lateral navigation/vertical navigation approaches (LNAV/VNAV). An LNAV approach is a non-precision approach (no vertical guidance) with a minimum descent altitude of 250 feet above obstacles on the flight path protected area. LNAV approaches can be conducted today with approach-certified GPS receivers. The FAA has published 2,732 LNAV approaches at general aviation airports, of which 37 percent are at airports with no vertically-guided instrument approaches and no previous straight-in instrument approach capability. An LNAV/VNAV approach is a vertically-guided approach with a decision altitude down to 350 feet or higher above the runway touchdown point, requiring a Wide Area Augmentation System (WAAS) certified receiver (not yet available) or certain flight management systems (FMS) with barometric VNAV. The LNAV/VNAV procedure falls between a non-precision approach with no vertical guidance and a true precision approach. LNAV/VNAV approaches allow more stable descent paths than traditional non-precision instrument approaches. The development of LNAV/VNAV approaches is a strategy to help reduce the risk of controlled flight-into-terrain at airports without an ILS, or when an ILS is out of service. In addition, the development of these approaches at airports that do not currently have an ILS increases access to these airports under low-visibility conditions. The FAA has published 234 LNAV/VNAV approaches.

The new RNAV approach charts will also include precision approaches using WAAS when it is certified for category I precision approaches. WAAS was intended to allow ILS-like CAT I approaches to 200-foot decision altitude and one-half mile visibility at airports with the appropriate lighting systems and runway markings. Although system accuracy has consistently exceeded CAT I standards in recent tests, system integrity has not yet met certification standards. Integrity describes the system's ability to detect a problem with the navigation signal and warn the pilot quickly.

It is unclear when WAAS will be able to provide CAT I capabilities, but WAAS is expected to deliver LNAV/VNAV approaches to U.S. airports by 2003. The availability of LNAV/VNAV approaches made possible by WAAS will greatly increase safety and access at smaller airports that do not have instrument approaches with vertical guidance.

5.6 Approaches to Closely Spaced Parallel Runways

At airports with closely spaced parallel runways, capacity is constrained in low-visibility conditions. When visibility is good pilots can conduct visual approaches to closely spaced parallel runways. But during periods of low visibility, simultaneous approaches to closely spaced parallel runways monitored by conventional airport surveillance radar are not permitted. For parallel runways separated by 2,500 feet to 4,300 feet, two arrival streams can be maintained but operations are limited to parallel dependent instrument approaches using 1.5 mile staggered separation. For parallel runways spaced less than 2,500 feet apart, operations are restricted to one arrival stream, which effectively reduces the airport's arrival capacity to one-half of its capacity in visual meteorological conditions. To help reduce the negative effect of adverse weather on arrival capacity, the FAA has developed several approach procedures that take advantage of the enhanced surveillance capability of the precision runway monitor (PRM).

The PRM is a surveillance radar that updates essential aircraft target information four to five times faster than conventional radar equipment. Using the PRM to monitor operations allows air traffic controllers to ensure safe separation of aircraft on parallel approach courses and maintain an efficient rate of aircraft landings on closely spaced parallel runways during adverse weather conditions. The FAA has commissioned PRMs at Minneapolis and St. Louis, and most recently, at Philadelphia International Airport in September 2001. PRMs are scheduled for commissioning at San Francisco and John F. Kennedy in mid-2002, and Atlanta in 2005, coincident with the completion of the fifth parallel runway.

The FAA has approved the following procedures utilizing a PRM to allow simultaneous instrument approaches in adverse weather:

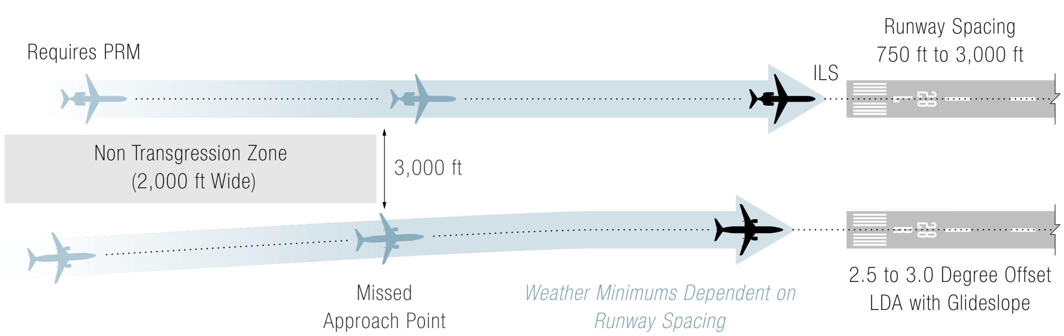
- Dual simultaneous instrument approaches for 4,300 feet-3,400 feet spacing (applicable to Minneapolis and the proposed new runway at St. Louis)
- Dual simultaneous instrument approaches down to 3,000 feet spacing with one instrument landing system (ILS) localizer offset by 2.5-3 degrees (proposed for Philadelphia and John F. Kennedy)

Two additional initiatives to allow better utilization of closely spaced parallel runways in low-visibility conditions include the simultaneous offset instrument approach (SOIA), and along track separation procedures. SOIA procedures have been developed but not yet implemented, and along track separation is at the conceptual stage of development.

5.6.1 Simultaneous Offset Instrument Approaches

The SOIA procedure would allow simultaneous approaches to parallel runways spaced from 750 feet to 3,000 feet apart. It requires the use of a PRM and an offset ILS localizer and glide slope (Figure 5-4). It requires the use of a PRM, a straight-in ILS approach to one runway, and an offset localizer directional aid (LDA) with glide slope approach to the other runway (Figure 5-4).

Figure 5-4 Simultaneous Offset Instrument Approaches



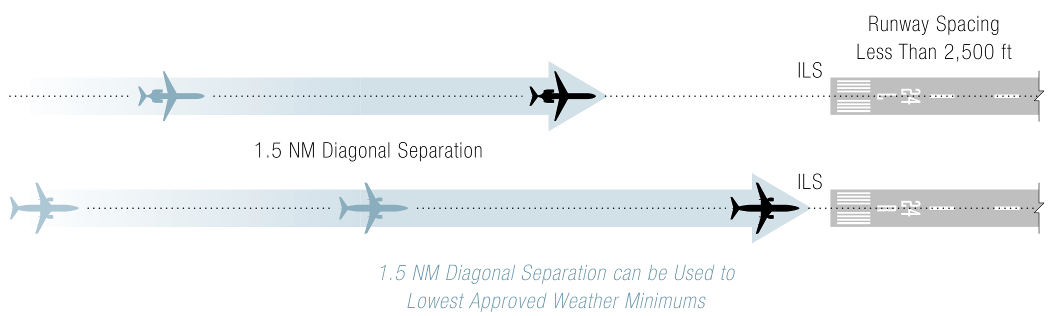
The SOIA concept involves the pairing of aircraft along adjacent approach courses separated by at least 3,000 feet with a designated missed approach point approximately 3.5 nautical miles from the runway threshold. The pilot on the offset approach would fly a straight-but-angled approach until descending below the cloud cover. At that point, the pilot would have a period of time to visually acquire the traffic on the other approach before continuing to the runway. If the pilot does not see the other aircraft before reaching the missed approach point, the approach would be discontinued.

San Francisco International Airport (SFO) is the first candidate airport for SOIA. At SFO the arrival rate is 60 aircraft per hour in clear weather using both parallel runways, which are 750 feet apart. In times of heavy fog and low-ceiling conditions, aircraft are placed in-trail to one runway, reducing the airport arrival rate by half. The SOIA procedure will enable SFO to maintain an arrival rate of up to 40 aircraft per hour with a cloud base as low as 1,600 feet and four miles visibility. The FAA has completed flyability, collision risk, and preliminary wake turbulence analyses for the SOIA procedure, but the PRM has not yet been commissioned. The PRM is expected to be operational by mid-2002. Other potential sites for SOIA include St. Louis, Newark, Cleveland, and Miami airports.

5.6.2 Along Track Separation

Along track separation is a proposal to increase arrivals to parallel runways spaced less than 2,500 ft. apart in periods of low visibility. The procedure entails parallel dependent instrument approaches staggered down to 1.5 nautical miles diagonally (Figure 5-5). The relevant safety analyses have not yet been conducted to determine whether a PRM would be required for this procedure to ensure safe separation.

Figure 5-5 Along Track Separation

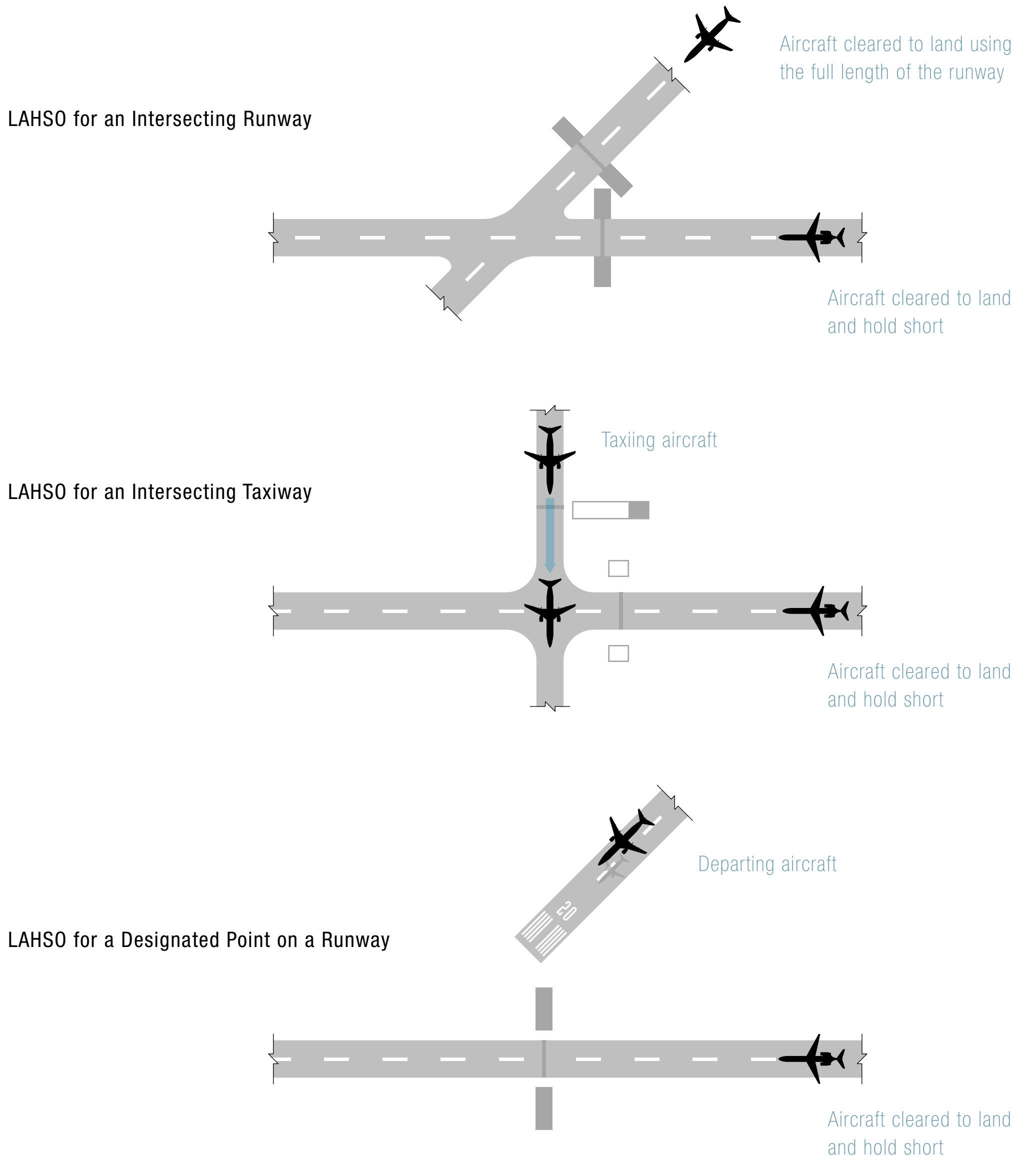


5.7 Land and Hold Short Operations

More than 30 years ago, the FAA began allowing simultaneous operations on intersecting runways, under restricted conditions, at a number of U.S. airports. Under this procedure, aircraft landing on an intersecting runway stop at a designated point before the intersection, allowing aircraft on the other runway to take off or land freely. This procedure increases airport acceptance rates by capitalizing on the fact that the full runway length is not necessarily required for an aircraft landing.

In 1997, the procedure was expanded to include landing and holding short of an intersecting taxiway, approach/departure flight path, or predetermined point on the runway other than a runway or taxiway, under the designation land-and-hold-short operations (LAHSO). The pilot-in-command retained the final authority to accept or decline any LAHSO clearance (Figure 5-6).

Figure 5-6 LAHSO Takeoff and Landing Procedures



In February 1999, the FAA, in coordination with the Air Transport Association (ATA) and the Air Line Pilots Association (ALPA), made a number of changes to the LAHSO procedure, such as limiting LAHSO to dry runway conditions.

In August 2000, the FAA issued revised standards containing three additional substantive changes. First, the means of determining the minimum available landing distance was modified so that the longest possible landing distance plus an additional safety margin will be used to determine whether LAHSO can be conducted for a given aircraft at a specific runway. Next, the new standards allow participation in LAHSO only by pilots who have been adequately trained in the maneuver. While most air carrier pilots have already been trained in LAHSO, the FAA needs to ensure that the remaining U.S. air carrier pilots and general aviation (GA) and foreign air carrier pilots receive adequate training. As of July 2001, mixed air carrier/GA LAHSO operations were still not being conducted due to training requirements for GA pilots. The training is expected to take two years to be completed.

The third substantive change was a requirement that no LAHSO be conducted on runways that require a rejected landing procedure until the procedure has been scientifically modeled and verified. Rejected landing procedures are required for airports where the geometry of the intersecting runway raises the possibility that each airplane would be in the air over the intersection at the same time. This last requirement has had a noticeable adverse impact on capacity at certain large airports. At the 19 largest U.S. airports, 39 intersecting runways where LAHSO was previously conducted require a rejected landing procedure. For example, about a quarter of Chicago O'Hare's daily operations were previously conducted on two intersecting runways (14R and 27L) in rapid succession when weather conditions permitted. Planes arriving on runway 14R stopped short of the intersection when an aircraft was departing on runway 27L. Because a rejected landing procedure is required, LAHSO has not been available for this particular runway combination. Similarly, the loss of LAHSO resulted in a reduction of six operations per hour at LaGuardia, and eight per hour at Boston under commonly used runway configurations. Other airports significantly affected by restricted use of LASHO include Philadelphia and St. Louis.

Modeling of rejected landing procedures for Chicago O'Hare, LaGuardia, and Miami indicates that the required margin of safety cannot be reached to make simultaneous LAHSO work. For example, modeling at O'Hare showed that if the arriving aircraft is more than 1.5 miles from the runway threshold, the departing aircraft can be cleared for takeoff safely. However, if the arriving aircraft is closer than 1.5 miles when the departing aircraft begins to takeoff, the two aircraft could possibly collide. An alternative to simultaneous LAHSO currently being explored is dependent LAHSO. Controllers would be permitted to clear a departing aircraft for takeoff before an arriving aircraft reaches 1.5 miles of the runway, or to clear the takeoff once the arriving aircraft is on the ground. Takeoff clearance would not be given during the last 1.5 miles of the arriving aircraft's approach.

6

NATIONAL AIRSPACE SYSTEM MODERNIZATION

This chapter provides an overview of the FAA's plans for the modernization of the NAS, including the NAS Architecture, the Capital Investment Plan, and the Operational Evolution Plan. It also provides an update on significant modernization projects, Free Flight operational tests and Safe Flight 21.

The NAS is a comprehensive plan for modernizing the NAS and improving services and capabilities through the year 2015. The architecture is a living document: it is a web-based information system that provides a continually updated picture of technical and procedural aspects of the NAS.[6]

The NAS Architecture was developed by the FAA in collaboration with the RTCA and is based on aviation community recommendations for a Free Flight operational concept. Free Flight centers on allowing pilots, whenever and wherever practical, to choose the optimum flight profile. This concept of operations is expected to decrease user costs, improve airspace flexibility, and remove flight restrictions.[7]

The FAA produces another planning document, the Capital Investment Plan (CIP), a subset of the NAS Architecture, every year. The architecture and the CIP are aligned to the Office of Management and Budget's (OMB) five-year budget planning guidance and funding proposed under the FAA reauthorization bill (AIR-21). The CIP balances investments among safety, security, and efficiency initiatives. Operating improvements are focused on sustaining existing core services, which provide traffic separation, navigation, communications, and traffic flow management. The current CIP for 2002-2006 aligns NAS modernization to the FY 2001 capital appropriation and OMB funding projections for FY 2002 through 2006.

In FY 2001, another subset of the NAS Architecture, the Operational Evolution Plan (OEP), was developed. The OEP is a joint FAA/industry effort to define the necessary safety analyses, staffing, certification, training, procedures development and airspace actions necessary to address capacity and demand problems in the NAS. The OEP was released to the public and presented to the Congress in testimony by the FAA Administrator in June 2001. As 2001 comes to a close, some OEP projects have been completed and other projects are being reclassified and rescheduled.

A key feature of the OEP is its identification of the responsibilities and duties of the key players in the industry, each of whom must make their own contributions in order to increase the capacity and efficiency of the NAS. Figure 6-1 lists the responsibilities and the commitments of the three key parts of the aviation community in implementing the findings of the OEP and by phase of the plan.

6 The complete NAS Architecture 4.0 and a summary called the Blueprint for NAS Modernization are posted on the FAA web site at www.faa.gov/nasarchitecture. The architecture database can be accessed through the Capability Architecture Tool Suite.

7 The NAS Architecture was reviewed by the RTCA in July 2001, which found it to accurately reflect the aviation community's requirements through 2001.

Figure 6-1 OEP Summary of Responsibilities and Required Actions

Near-Term 2001

Airports	➢ Reach agreement with pilots on LAHSO procedures and assumptions ➢ Training on closely spaced approach procedures ➢ Improve quality of data and participation in Spring 2001 collaboration ➢ Participate in Spring 2001 training ➢ Improve information dissemination to passengers ➢ Improve and share demand forecast data ➢ Reevaluate scheduling practices at congested airports
FAA	➢ Runway incursion training and awareness for controllers ➢ Conduct safety analyses for LAHSO ➢ Parallel runway monitors at selected airports ➢ Improve dissemination of routing information and weather to facilities ➢ Develop and conduct Spring 2001 training ➢ Resolve airspace choke points by adding new sectors and moving flows in NE ➢ Improve currency and accuracy of SUA status information and expand internet access ➢ Streamline EIS processes ➢ Improve information dissemination to passengers ➢ Expand use of 3-mile separation standard where applicable ➢ Start FFP2 program
Airports	➢ New runways at Detroit and Phoenix ➢ Additional precision approaches at 14 airports ➢ Work with communities to implement capacity plans ➢ Streamline EIS processes ➢ Improve information dissemination to passengers

Mid-Term 2002-2004

Airlines	➢ Accelerate equipage to take advantage of RNAV routes and approaches ➢ Ensure uniform datalink equipage ➢ Reevaluate scheduling practices at congested airports
FAA	➢ Expand implementation of RNAV procedures ➢ Provide staffing and equipment for new runways ➢ Parallel runway monitors at selected airports ➢ Complete FFP1 program ➢ Expand airspace redesign, start to implement RVSM ➢ Complete WAAS Phase 1 (LNAV/VNAV) ➢ Implement LAAS approaches ➢ Add datalink and ADS-B capabilities
Airports	➢ New runways/extensions at Houston, Minneapolis, Miami, Orlando, Charlotte, Denver ➢ Improve surface management process and coordination ➢ Start LAAS implementation ➢ Add signs and lighting at smaller airports to take advantage of new navigation Systems

Long-Term 2005-2010

Airlines	➢ Equip for enhanced situational awareness on airport surface ➢ Equip and train for new LAAS systems
FAA	➢ Transition to single facility operation in New York ➢ Continue TRACON consolidation ➢ Implement RVSM ➢ Complete WAAS Phase 2 ➢ Expand use of datalink for ATC
Airports	➢ New runways and taxiways at Atlanta, Cincinnati, Dallas, St. Louis, Seattle, Dulles ➢ Enhance surface congestion management ➢ Continue to add capacity through taxiway and runway enhancements

NAS Modernization has been designed as an evolutionary process that will sustain current NAS operations while new technologies are introduced, proven, and then deployed. This process will allow for a smooth transition from one technology to another, sufficient time for users to equip, and realistic schedules for service providers to test, train for, and deliver services.

6.1 Update on NAS Modernization

NAS modernization is an ongoing process that builds upon the implementation of individual projects to improve the effectiveness of the entire NAS. The 2000 ACE Plan reported on several significant milestones in NAS Modernization:

- The deployment of the Display System Replacement (DSR) equipment, the first major component of the en route air traffic control system infrastructure, which was completed on time and within budget.
- The completion of the HOST and Oceanic Computer Replacement, which replaced aging computers at the centers with new equipment with higher reliability, has improved maintainability, and more complete backup capability.
- The installation of the Common Automated Radar Terminal System to upgrade the dated system at 133 small-to medium TRACONS and to enhance the existing systems at five large TRACONS.

The incremental nature of NAS modernization means that these accomplishments provide the foundation for subsequent projects. In the past year, the main focus of NAS modernization has switched from the en route environment to the terminal area, focusing on the development and early prototypes of the Standard Terminal Automation Replacement System, the beginning of the HOST software rewrite, and the development of the Local Area Augmentation System. Each of these initiatives is described briefly below.

6.1.1 The Standard Terminal Automation Replacement System

The Standard Terminal Automation Replacement System (STARS) is a joint FAA and Department of Defense program to replace automated radar terminal systems (ARTS) and other capacity-constrained, older technology systems at 172 FAA and up to 199 Department of Defense terminal radar approach control facilities and associated towers.

Controllers will use STARS to provide air traffic control services to aircraft in terminal areas. Typical terminal area air traffic control services include: the separation and sequencing of air traffic, the provision of traffic alerts and weather advisories, and radar vectoring for departing and arriving traffic. The system will reduce the life-cycle cost of ownership, accommodate air traffic growth, and provide for the introduction of new automation functions that improve the safety and efficiency of the NAS.

6.1.2 The HOST Software Rewrite

In 1999 the hardware for the air traffic control system was successfully replaced. The HOST and Oceanic Computer Replacement program replaced the interim computers that had served the ATC system from the mid 1980s to the present. However, the basic en route center automation system, which receives, processes, coordinates, distributes, and tracks information on aircraft movements throughout the nation's airspace, is based upon the original, often modified, software. Those programs were written in a computer language, JOVIAL, that is not widely used now and therefore are difficult to upgrade to accommodate new requirements.

The FAA is developing the En Route Automation Modernization (ERAM) program to replace the current NAS software and to add the capabilities required to support NAS modernization. ERAM will provide an open standards-based system that will incorporate commercial off-the-shelf and non-developmental items as much as possible. ERAM will make it easier to integrate new capabilities into the system, reduce the training needed to maintain the system, and offer enhanced simulations. The FAA is in the process of seeking industry comment on a draft ERAM package and will award a contract after appropriate review.

6.1.3 Local Area Augmentation System Development

The Local Area Augmentation System (LAAS) is an augmentation of the global positioning system (GPS) that will provide highly accurate navigation signals to suitably-equipped aircraft. LAAS will provide Category II/III precision approach and landing capability and accurate navigation signals for aircraft and vehicles on the airport surface.

The LAAS program was designed as a collaborative project between the FAA and the private sector. During the past year this approach has made significant advances towards the implementation and actual use of this advanced navigation and guidance system. Federal Express has been the leading participant in this effort and has conducted a number of successful trials at its Memphis base.

6.2 Free Flight Operational Tests

Modernizing the NAS has inherent risks because many of the new technologies have not been operationally tested. To minimize these risks and to gain a better understanding of potential challenges, the FAA has developed two risk mitigation strategies: Free Flight Phase 1 and Safe Flight 21. These programs are intended to reduce technical and financial risks through the implementation of select technologies at specific sites for evaluation by NAS users and the FAA prior to full implementation.

6.2.1 Free Flight Phase 1

The Free Flight Phase 1 (FFP1) Core Capabilities Limited Deployment initiative was designed to deliver early benefits of free flight to NAS users while mitigating the risks of implementing new technologies. Under this initiative, the FAA is evaluating five technologies: the User Request Evaluation Tool, the Traffic Manager Advisor, the Center TRACON Automation System Terminal, the Surface Movement Advisor, and Collaborative Decision Making. Each of these technologies is described briefly below.

User Request Evaluation Tool

The User Request Evaluation Tool (URET) extracts real time flight plan and tracking data from the Host computer, builds flight trajectories for all flights within or inbound to the center and identifies potential separation conflicts, up to 20 minutes in advance. URET will permit greater route flexibility within en route airspace by enabling controllers to more effectively manage user requests.

Traffic Management Advisor
The Traffic Management Advisor (TMA) received a major aviation award for its accomplishments in increasing the efficiency of the ATC system. The TMA provides en route controllers and traffic management coordinators with automation tools to manage the flow of traffic from a single center into selected major airports, with consideration given to separation, airspace, and airport constraints.

Center TRACON Automation System Terminal
The Center TRACON Automation System (CTAS) Terminal system provides increased situational awareness in terminal airspace through the use of auxiliary displays at controller positions and large screen displays at the Traffic Management Unit. The Southern California TRACON controllers have accepted the CTAS terminal adaptation and it is being delivered to additional sites.

Surface Movement Advisor
The Surface Movement Advisor (SMA) increases awareness of traffic flows into an airport, giving ramp control operators precise touchdown times. This updated information assists airline operations in managing myriad ground resources at the terminal more efficiently, including gates, baggage handling, food services, refueling, and maintenance. Gate and ramp operators using SMA are informed of aircraft identity and position in terminal airspace, which improves their ability to reduce gate delays.

Collaborative Decision Making
Both a philosophy of traffic management and an array of computer tools that facilitate a real-time collaboration between the FAA, and the airlines, Collaborative Decision Making (CDM) provides FAA traffic flow managers and airline dispatchers with the same real-time information. It links the FAA with the dispatch systems of the airlines and provides the airlines with access to NAS data, including weather, equipment, and delays. CDM allows the FAA to manage the air traffic system more efficiently and the airlines to employ their aircraft more effectively.

6.2.2 Results of Free Flight Phase 1 Deployment
The FFP1 program has been successfully implemented at all of its initially planned sites and has been extended to others. In addition, the new technologies are bringing real and measurable improvements.

User Request Evaluation Tool prototypes are being used 22 hours a day at the Indianapolis and Memphis centers. Both facilities are providing increased direct routings to users, resulting in savings in aircraft direct operating costs of $1.5 million per month. Also, the Indianapolis center has eliminated more than 22 altitude restrictions, saving users nearly $1 million per year in fuel costs. URET is being deployed at five additional centers.

The Traffic Management Advisor is fully operational at three centers, providing metered traffic flows to the Dallas/Ft. Worth, Denver, and Minneapolis airports. In addition to more fuel-efficient flows, TMA has increased peak capacity at these airports by 2-to-5 percent. Additional TMA systems are deployed at centers feeding traffic to Atlanta, Los Angeles, San Francisco, and Miami airports, where the controllers use TMA to provide increased situational awareness, leading to more efficient traffic flows.

CTAS Terminal maximizes runway use by providing enhanced situational awareness at TRACONs. CTAS Terminal is operational at the Southern California TRACON, where it has increased peak capacity by three percent while reducing inefficient holding close in to the affected airports.

The Surface Movement Advisor was the first Free Flight Phase 1 program to be completed. Feedback from the airlines has been very positive; Northwest Airlines has estimated that it has been able to avoid three-to-five costly diversions weekly, especially during periods of inclement weather. Four additional airlines are currently using SMA data to improve operations.

Collaborative Decision Making allows airspace users and the FAA to share information, enabling the best use of available resources. The National Airspace System Status Information (NASSI) tool is the most recent CDM element to be completed. NASSI enables the real-time sharing of a wide variety of information about the operational status of the national airspace system. Much of this information has previously been unavailable to, or unusable by, most airspace users and service providers. NASSI includes information on includes maintenance status, runway visual ranges at over 30 airports, and the availability of Special Use Airspace.

6.2.3 Free Flight Phase 2

Free Flight Phase 2 (FFP2) builds on the successes of Free Flight Phase 1 to improve safety and efficiency within the NAS. FFP2 includes the east-to-west expansion of Phase 1 elements, including URET and TMA, to additional FAA facilities. FFP2 will provide incremental enhancements to URET and TMA during the period 2003-2005. FFP2 will deploy a number of additional capabilities,such as CDM with Collaborative Routing Coordination Tool enhancements and Controller Pilot Data Link Communication, which are described briefly below.

CDM Collaborative Routing Coordination Tool is a set of automation capabilities that can evaluate the impact of traffic flow management re-routing strategies. En route congestion management is a major focus of this tool.

Controller Pilot Data Link Communication (CPDLC) augments voice communications for limited number of air traffic messages and will provide a second communications channel for use by the pilot and controller, using data messages that are displayed in the cockpit. This will reduce delays resulting from congestion on voice channels. The initial version of CPDLC, Build 1, will use digital data link technology to provide an operational evaluation for implementing en route data links. CPDLC Build 1A and Build 2 will expand the message set to include additional key flight data and support pilot-initiated requests.

Under FFP2, the FAA (and its collaborators) will conduct selected research activities to extend certain FFP1 capabilities and to develop others. Research activities in FFP2 include the Multi-center Traffic Management Advisor, the Surface Management System, the Direct-To-Tool, and the Problem Analysis, Resolution and Ranking (PARR) function.

6.2.4 Safe Flight 21

Safe Flight 21 is a five-year government and industry effort to demonstrate the capabilities of advanced communication, navigation, surveillance, and air traffic procedures associated with Free Flight. Safe Flight 21 expects to validate the modernization effort and accelerate its progress, while minimizing the long-term risks and costs. The Safe Flight 21 initiative will focus primarily on developing a suitable avionics technology, pilot procedures for air-to-air surveillance of other aircraft, and a compatible ground-based automatic dependent surveillance system for air traffic control facilities. The Safe Flight 21 initiatives will demonstrate the usefulness of two new technologies:

Automatic Dependent Surveillance-Broadcast and Cockpit Display of Traffic Information

A surveillance system that continuously broadcasts GPS position information, aircraft identification, altitude, velocity vector, and direction to all other aircraft and air traffic control facilities within a specific area. Automatic Dependent Surveillance-Broadcast (ADS-B) information will be displayed in the cockpit via a cockpit display of traffic information (CDTI) unit, providing the pilot with greater situational awareness. ADS-B transmissions will also provide controllers with a more complete picture of traffic and will update that information more frequently than will other surveillance equipment. On the surface, ground vehicles can also use ADS-B and CDTI to be visible to, and to see, taxiing aircraft.

Traffic Information System-Broadcast/Flight Information Service

The Traffic Information System Broadcast (TIS-B) and the Flight Information Service (FIS) are communications systems that will transmit traffic, weather, and other information available on the ground to the cockpit. TIS-B/FIS will also provide pilots with greater situational awareness.

The Safe Flight 21 program will also quantify operational benefits, demonstrate capabilities, and collect data on the performance of three candidate data link technologies for air-to-air surveillance: Mode Select (Mode S) Extended Squitter, Universal Access Transceiver, and VHF Data Link (VDL) Mode 4. Safe Flight 21 demonstration projects have been initiated at two sites: in the Ohio River Valley in collaboration with the Cargo Airline Association and in western Alaska with commercial aircraft providing passenger, mail, and freight services. A common design is being used for the two project sites to facilitate the collection and analysis of data.

6.2.4.1 Ohio River Valley Project

Safe Flight 21's Ohio River Valley Project is testing ADS-B avionics on commercial cargo aircraft in the Ohio River Valley. These tests are taking place in terminal areas with significant cargo operations, including Memphis, Tennessee; Wilmington, Ohio; Louisville, Kentucky; Scott Air Force Base, Illinois, and Nashville, Tennessee. The Ohio River Valley Project is co-sponsored by the Cargo Airline Association (CAA) and the FAA. The CAA has purchased, equipped, and is maintaining the avionics for the test aircraft. The CAA members are conducting revenue flights with these aircraft to evaluate the systems' performance in normal operations.

The FAA has purchased, installed, and is maintaining ground systems at the five sites. A ground broadcast server has been installed at the Wilmington site that receives data from the other sites and depicts ADS-B targets fused with radar targets. As the project proceeds, fused ADS-B and radar target data will be made available to suitably-equipped aircraft to enable the pilots to see both targets on a cockpit display, along with selected broadcast information such as weather maps, special use airspace status, and wind shear alerts.

The Ohio River Valley Project is being assessed in a series of Operational Evaluations. The first evaluation demonstration took place in July 1999 at the Wilmington site. It concentrated on measuring the improvement in the test aircraft's ability to make approaches in low visibility conditions and their enhanced ability to see and avoid adjacent traffic. Cargo carriers, the FAA, NASA, the military, and academia participated in this initial evaluation. During the demonstration, aircraft equipped with ADS-B enabled pilots to consistently maintain close separation.

The second operational evaluation took place in October 2000 at the Louisville site, with some 20 aircraft. CAA members provided eight aircraft and other participants, such as NASA, the U.S. Navy, and the Aircraft Owners and Pilots Association provided additional aircraft for the trials. The third operational evaluation took place at the Memphis site in May 2001. It followed up on the successes of the previous trials and demonstrated additional capabilities of the avionics technology.

6.2.4.2 Alaska Capstone Program

The Capstone Program was developed by the FAA in response to an National Transportation Safety Board (NTSB) safety study, Aviation Safety in Alaska, to address Alaska's high accident rate for small aircraft, which is five times the national average. A recent FAA-sponsored study estimated that 38 percent of commercial operator accidents in Alaska could be avoided if information on position relative to terrain and real-time weather information were available to pilots in the cockpit. The principal objective of the Capstone Program is to improve pilots' situational awareness of the flight environment and to thereby avoid mid-air collisions and controlled flight into terrain. Although the FAA plans to initially demonstrate the benefits of these technologies in Alaska, it will eventually extend those technologies to the entire NAS.

The FAA has equipped 120 commercial aircraft in a non-radar environment in the Yukon-Kuskokwim Delta region of southwest Alaska with the Capstone avionics suite. It includes a cockpit multifunction display, a GPS navigation/communications unit, a Universal Access Transceiver data link unit, and a GPS-based terrain database of Alaska.

The suite enables each participating aircraft to broadcast its identification, position, and altitude, climb rate, and direction and to receive similar signals from other aircraft.

The FAA has begun the installation of a network of data-link ground stations that will transmit radar targets of non-participating aircraft to the Capstone aircraft. In addition, the ground stations will transmit flight information services, including weather reports and forecasts, maps, status of special use airspace, pilot reports, and notices to airmen. The FAA is also publishing non-precision approaches and installing automated weather observation systems at ten village airports in the Delta region.

The University of Alaska-Anchorage (UAA) conducted training sessions for Capstone and has completed an in-depth safety study of Capstone. UAA has begun training a cadre of instructors who will in turn conduct individual company training. The training program began in Bethel, Alaska in early February 2000 and will continue until each participating commercial company has at least one fully trained instructor and a complete set of Capstone modules with reference library materials. The safety study is assessing the benefits of the Capstone avionics and the use of new flight procedures.

The initial improvements of Capstone are directed towards pilots conducting Visual Flight Rule (VFR) operations. In the future, the FAA plans to certify systems and equipment and develop enhanced operational procedures for Instrument Flight Rule (IFR) operations. When this is accomplished, ADS-B can be used for air traffic control functions just as radar is now used.